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THE TRULY PSYCHOLOGICAL BEHAVIORISM

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The swing of present-day psychology toward what is known as behaviorism is due to the recognition, explicit or implicit, of the over-abstraction of traditional psychology. In ever greater numbers men endorse the behavioristic platform and turn from the exclusive pursuit of mental process or function to concern themselves with the individual in reaction on his concrete environment. The writer of this paper is convinced of the hopeful significance of this adoption, by psychologists, of the cardinal principle of behaviorism. But the widening of the psychological outlook has its attendant risks. In their revulsion from psychological abstractions there is danger that our *soi-disant* psychologists turn away from psychology altogether; in their uncritical adherence to behaviorism there is danger that they fail to challenge its conceptions and to distinguish its divergent types. This paper proposes a study of these conceptions and types.

Behavioristic psychology, as it exists to-day, is the study of the animal in reaction on his environment. Two forms must be sharply contrasted. (1) The first, extreme behaviorism, distinguishes the human animal from non-human animals solely in terms of his type of bodily reactions. This means that extreme behavioristic psychology denies or ignores what are known as mental phenomena. Its categories are qualitatively the same as those of the behavioristic study of non-human animals. (2) Modified behavioristic psychology attributes to the human animal, the object of its study, consciousness as well as bodily reaction; it teaches that

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consciousness is directly or immediately observed; and it accordingly distinguishes psychological from non-psychological behaviorism in that the former involves not merely the observation of physiological reactions but self-observation, or introspection, as well. To a study of these two forms of behaviorism, Parts I. and II. of this paper are devoted. The concluding section will sketch a behaviorism of a somewhat different type.

I. Extreme Behavioristic Psychology

The most prominent upholder of radically behavioristic psychology is Professor John B. Watson, and the most systematic presentation of his doctrine is his recent 'Psychology from the Standpoint of a Behaviorist.' Upon this book the following discussion is mainly based. Psychology, according to Professor Watson, is the study of the reactions that the totally integrated 'individual makes to his environment.'[1] By 'individual' is meant the human body. Psychology is, accordingly, distinguished from physiology precisely and only in that physiology is concerned with 'the functions of the special organs,'[2] whereas psychology deals with the 'whole organism' in its relation to 'its environment as a whole.'[3] Consciousness, sensation, perception, attention, emotion, thinking, memory and will are either ignored on the ground that the psychologist 'can get along without them'[4] or they are 're-defined in conformity with behavioristic psychology,' that is to say, in terms of the organism's reactions to the environment.

Upon this foundation Watson erects a simple edifice. He studies the human animal's reactions under two main heads, (1) hereditary modes of response, either emotions[5] or instincts[6] and (2) habits,[7] or acquired responses, which he distinguishes

[1] *Op. cit.*, p. 13^2. Cf. pp. viii, 12, 20, 48, 193^3, 209 end.
[2] *Op. cit.*, pp. 19^3 f., p. 193^3 *et al.* (Note the qualification of this statement, p. 19^2.)
[3] *Op. cit.*, p. 20^1.
[4] *Op. cit.*, p. viii.
[5] *Op. cit.*, Chap. VI., pp. 195 ff.
[6] *Ibid.*, Chap. VII., pp. 231 ff.
[7] *Op. cit.*, Chap. VIII., pp. 269 ff.

both as explicit or implicit[1] and as verbal or non-verbal.[2] In more detail: instincts are marked off from emotions both as relatively coördinated and as involving 'movements principally of the striped muscles,'[3] whereas emotional changes include those of the glandular system[4] and are described as throwing 'the organism for the *moment at least* into a chaotic state.[5]

From both emotion and instinct, habit is clearly marked off as 'any definite mode of acting, explicit or implicit, not belonging to man's hereditary equipment.'[6] Watson rightly points out that the difference is genetic, not structural. "Instinct and habit," he says, are "undoubtedly composed of the same elementary reflexes. They differ so far as concerns . . . origin."[7] He stresses particularly the distinction between (1) explicit habits (verbal or non-verbal), the 'overt' activities of the 'whole body' or of 'the motile organs of the striped muscle system,[8] and (2) the 'implicit habit systems,' observed only 'with the aid of instruments,' consisting either in 'conditioned reflexes, in the glands and in the unstriped muscles,[9] or else in implicit bodily movements of throat, tongue, larynx or of shoulders and hands, for example. To verbal habits, in particular, Watson devotes much attention. "Man," he says, "is above all an animal which reacts most often and most complexly with speech reactions."[10] What traditional psychology calls thought—and under this head Watson seems to include both imagery and will—he identifies with language-habits. It follows that thought "is not different in essence from tennis-playing . . . or any other overt activity except that it is hidden from ordinary observation and is more complex and at the same time more abbreviated."[11]

[1] *Op. cit.*, pp. 273 f., *et al.*
[2] *Ibid.*, Chap. IX., pp. 310 ff.
[3] *Op. cit.*, p. 231[2].
[4] *Op. cit.*, p. 195[2].
[5] *Op. cit.*, p. 196.
[6] *Op. cit.*, p. 270[2].
[7] *Op. cit.*, p. 272[2].
[8] *Op. cit.*, p. 273[2].
[9] *Op. cit.*, p. 274[2].
[10] *Op. cit.*, p. 38[3].
[11] *Op. cit.*, p. 325[1].

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Creative thought is simply 'constructive laryngeal work.' [1]

The preceding pages, though neglecting entirely the point of greatest positive value of Watson's book (its report of the experimental study of instinctive responses of babies) summarizes the important positions of extreme, or radical, behavioristic psychology.[2] On this conception the following criticisms must be made.

The conception may be challenged, in the first place, for departing too widely from the historical conceptions of psychology and biology. Watson himself admits that 'historically considered' his 'program leaves out many of the factors with which psychology ought to be concerned";[3] and it certainly ignores the conventional conception of zoology in claiming for the study of the integrated, reacting animal the name 'psychology.'

The objection to radical behavioristic psychology is not, however, merely or mainly, its break with the traditional use of the terms 'psychology' and 'zoölogy.' The real difficulty is that radical behavioristic psychology leaves uninvestigated, or else inadequately analyzed, observed facts which must fall within the field of psychology since admittedly they are not material for physical or physiological science. This statement of course embodies the attitude of all psychologists, save the radical behaviorists themselves, toward the extreme behavioristic position that the psychologist has no concern either with consciousness or with the conscious self. Titchener and Ward, Wundt and Stumpf, Angell and Pillsbury, whatever their disagreements, are united

[1] *Ibid.*, p. 330[2].

[2] It may be added that, in spite of the generally remarkable consistency of Watson's exposition, he none the less occasionally indulges in forms of expression incompatible with strict behaviorism. Thus he speaks of self-observation as 'expressed in words' and of thought as 'couched in words' (pp. 42[2], 325[2]), singular expressions if thought really *is* language. In somewhat similar fashion, he speaks of the 'outlet' of emotion (p. 214) though emotion, as hereditary response, can hardly be conceived as having an outlet. The occasional slip-back into conventional expression is of course no proof of essential inconsistency, though it certainly suggests the untenability of the behaviorist's position.

[3] *Op. cit.*, p. 8[2].

in the conviction that perception, attention, will and the rest are genuinely observed facts of experience, that as such they merit scientific study and that psychology is the science that should study them. To this, however, Watson responds that he 'frankly' does not know what 'such terms as sensation, perception, attention, will, image . . . mean'; and that he does not 'believe that any one else can use them consistently.'[1] These expressions seem at first blush to close the discussion as effectually, though perhaps as unscientifically, as the asseveration of the sceptical countryman who, faced with the hippopotamus, still declared: 'there ain't no such animal.' But an indirect argument is left to the critic of Watson as exponent of radical behaviorism. It can be shown that he himself makes use of psychological concepts which he is unable to analyze into terms of bodily reaction. With the development of this criticism, the remainder of Part I. of this paper is chiefly concerned.

Two main instances of Watson's unsuccessful attempt to apply exclusively non-mental categories will be given. (1) He is unsuccessful, in the first place, in differentiating given sensations within a single sense-type or department. The sense-types, visual, kinaesthetic, and olfactory, for example, he readily distinguishes as different kinds of reaction, eye-movement, arm, leg or body movement, sniffing reaction and the like. But he has also to take account of the different kinds of visual, of olfactory, and of kinaesthetic sensation. And he has expressly abjured the introspective psychologist's doctrine that these are indescribable, elementary ways of being conscious. It is greatly to Watson's credit that he does not ignore this problem and that he does not try to meet it by substituting for his behavioristic conception of sensation, as *consisting in* bodily reaction, the utterly different conception of sensation as *dependent on* neural excitation. His procedure is thoroughly consistent: "If," he says, "we take a normal human subject and stimulate his retina with monochromatic light beginning with 760 $\mu\mu$ and then advancing to shorter wave-lengths, and ask him to react to them

[1] *Op. cit.*, p. viii.

verbally in order, he will say, 'I see red' from 760 $\mu\mu$ to 647 $\mu\mu$, ['I see] orange from 647 $\mu\mu$ to 586 $\mu\mu$,' ['I see] yellow from 586 $\mu\mu$ to 535 $\mu\mu$,'" *etc.*[1] In a word, Watson distinguishes these visual sensations from each other as consisting in different verbal reactions, the distinct vocal habits involved in saying 'red' and 'yellow.' Watson adds, to be sure, that 'we can get the observer to do more than name the colors' but his instances of non-verbal reaction to 'fine differences' turn out to be such as wine-tasting and silk-buying, complex responses, and not simple sensory reactions at all. It is in truth impossible to imagine any save verbal reactions which serve invariably to distinguish the bodily response to objects differing only in sense quality. Nothing, for example, save the verbal reaction 'blue' instead of 'white' can be supposed to distinguish one's *merely sensational* response to a blue hydrangea from one's response to a white one. But the conception of sensation-differences as distinctions of verbal reaction loses whatever plausibility it has in face of the simple consideration that in different situations different vocal responses follow on identically the same stimuli. When, for example, an untutored husband is corrected by his sophisticated wife for describing as 'pink' the chiffon scarf which she unhesitatingly calls 'cerise' it is not to be supposed that their sensations differ. The same consideration holds with regard to the different vocal responses of men of different nationality to the same stimulus. If one stimulates a Frenchman's retina with monochromatic light from 586 $\mu\mu$ to 535 $\mu\mu$, his reaction is 'jaune,' not 'yellow.' Obviously, the so-called sensation of yellow cannot *consist in* a verbal reaction, when identically the same sensory stimulus calls forth radically different reactions.

(2) The difficulty recurs in the case of thought, which Watson precisely identifies with language implicit or explicit and by which, it should be noted, he designates deliberative as well as purely cognitive experiences.[2] This teaching is so central to Watson's doctrine that it should be reproduced in

[1] *Op. cit.*, p. 88[2].
[2] *Op. cit.*, 332[3].

his own words. "Thought," he says, is "a bodily process like any other act;" [1] when, therefore, "we study implicit bodily processes we are studying *thought*; just as when we study the way a golfer stands in addressing his ball and swinging his club we are studying golf." [2] The implicit processes in which thought consists are largely, though not wholly, laryngeal. Indeed, the chief argument adduced for this conception of thought is the fact that 'many investigators' have 'set their subjects such problems as . . . subvocal arithmetic' and have then studied 'movements of the larynx (externally by attaching tambours to the neck)' finding 'in general good evidence of orderly movements similar to those in speaking. . . . Occasionally,' to be sure, such records of laryngeal movements "fail to appear even when a subvocal problem in arithmetic is worked out and the proper answer returned." [3] Accordingly, though Watson attributes the 'negative evidence' to 'our present inexact methods' [4] he frankly admits that this theory of 'implicit processes is largely an assumption' [5] though a 'reasonable' one, 'backed up,' he says, 'by the whole development of psychology, physiology, and science generally.' But these are generalities. If the behavioristic 'assumption' that a thought *is* a laryngeal bodily reaction, is justified, it must be possible to analyze specific dissimilar thoughts in terms of dissimilar laryngeal reactions and must be equally impossible to find resembling thoughts which consist in radically different subvocal reactions. In the attempt to meet this test the theory is utterly shattered. To take Watson's own example from geometry. On his view, the solution of a proposition consists essentially in a series of laryngeal reactions. But the identical solution of the same problem involves totally different laryngeal reactions, if the mathematicians talk in different languages—if one, for example, speaks of *Winkel* while the other talks about angles.[6]

[1] *Op. cit.*, p. 325[2]. [2] *Op. cit.*, p. 326[2].
[3] *Op. cit.*, p. 326[3]. [4] *Ibid.* [5] *Ibid.*, p. 326[2].

[6] Henry More's spirited criticism of nominalistic doctrine, written more than two centuries ago, makes what is virtually the same point. "To call these Secondary Notions mere Names is," he says, "sheer nonsense. For on that supposition, since

To elaborate this criticism would be futile. Radical behaviorism, whatever its achievements, its discoveries, and its uses, simply is not psychology at all. For it confessedly ignores facts which psychology has always treated and it fails to reduce to terms of bodily reaction those psychic phenomena of which it takes account. A behavioristic psychology, it is evident, must be behavioristic in some other sense of the term. And this conclusion leads to the study of that form of behaviorism which makes room for consciousness.

II. Modified Behavioristic Psychology

Modified behavioristic psychology—most recently set forth, though not under this title, in Professor H. C. Warren's 'Human Psychology'—differs, as has just been stated, from radical behaviorism by regarding the human animal as possessed not only of bodily reactions but of consciousness. Like every form of behaviorism, it describes psychology as 'the science which deals with the mutual interrelation between an organism and its environment,'[1] but it protests against ruling out 'the data of consciousness.'[2] In agreement with the functional psychology of the 1900's,[3] it teaches that different kinds of consciousness are themselves forms or aspects of the reaction of organisms on their environment. A characteristic argument against the deportation of consciousness from psychology is readily built up out of Warren's statements, though he does not explicitly formulate it. It starts from the premise that the concept of behavior must be

their names vary, Mathematical and Logical Notions would vary with different tongues: since certainly the Latins call the same thing by the term *Similitudo* which the Greeks call ὁμοιότης, whereas the Greeks call that ἀνολογία and λόγος which the Romans call *Proportio* and *Ratio*, and so of other notions."—'Euchiridion Metaphysicum,' Ch. XXV., end.

[1] 'Human Psychology,' p. 13[2].

[2] *Ibid.*, p. 431, note.

[3] Both forms of behaviorism are really derived from functional psychology though only modified behaviorism has run close to type. The main difference lies in the fact that the functionalists take the psychophysical organism (mind and body or mind in body) as unit of their science whereas behavioristic psychologists of every type have, at the present time, supplanted the psychophysical by the physical organism, the body. But functional psychology treats consciousness as a significant function, though coördinate with the merely physiological functions of the psychophysical organism.

widened to include the whole sensory-central-motor arc. But the central processes, it is pointed out, are known never directly, but only by inference from consciousness. It is therefore impossible to define perceiving, thinking, and emotion in terms of bodily reaction precisely because the reaction includes a central process which can be known only through consciousness. In other words: 'The brain center' cannot be directly observed or measured. 'We have to rely entirely on the results of self-observation' in order to know it. What 'we observe and report' are 'our sensations. To these, we infer, there correspond 'physiological processes in the brain."[1]

It is unnecessary to enforce or to elaborate this decisive argument for reinstating consciousness in psychology. The trouble with the modified behaviorist is, however, that having recovered consciousness he seems not to know exactly what to do with it. For in coördinating consciousness, as a function or response of the organism, with physiological reactions, he has slurred the empirically observed difference between consciousness and bodily reaction, between the conscious self and the reacting organism. Now it well may be, as both materialistic and idealistic philosophers insist, that the difference between the mental and the non-mental, between consciousness and bodily reaction, is not ultimate. But, however superficial the difference, it is none the less real; it is indeed the basis of the distinction between psychological and non-psychological sciences. Let one, for example, compare (*a*) the experience of seeing green and (*b*) the complex bodily processes correlated with the experience, the retinal excitation, the afferent, central and efferent neural processes and the muscular adjustment. Certainly, the two occurrences (*a*) and (*b*) are not identically the same. We directly know (as all modified behaviorists agree) what we mean by seeing green and what we mean by the bodily processes described above, and while we believe that this sensation of green is either due to, or else correlated with, the complex of bodily processes, we know that the two are neither identical nor even wholly coördinate; that they are facts of different

[1] *Op. cit.*, p. 77[2]. Cf. p. 58[4].

orders or levels. This difference, however, the modified behaviorist certainly obscures and he may even end, in complete disregard of his basal conception of consciousness, by denying altogether. Warren reaches this extreme position and the critical exposition of the following pages is based specifically on his teaching.

It has already appeared that consciousness seems, according to Warren, to win its place in psychology by the fact that the central nerve-processes, so far from being facts directly observed, become facts for the scientist only by inference from mental phenomena to which (to use Warren's occasional phrase) the brain processes correspond.[1] But instead of abiding by this neutral and impeccable phraseology of correspondence Warren adds: 'the central effect of stimulation observed in ourselves is called a sensation.'[2] "*Both sensations and ideas*," he elsewhere says, "*are central processes*";[3] and again, "the resulting central process is . . . an idea."[4] By another set of statements Warren conveys the same teaching under cover of an 'as.' Thus, he declares that 'self-observation is examination of the central adjustment phenomena as mental states';[5] and again, that 'one observes in himself as volition' a 'complex central process.'[6]

The insuperable obstacle to this literal identification of consciousness (of perception or volition, for example) with brain process has already been named: the two are different to direct observation. 'Tasting saltiness' is no more truly identical with a metabolic variation in a brain-center than with a laryngeal reaction; or (to re-state the position), it would be impossible to substitute, in intelligible discourse, a term descriptive of some internal temporal lobe process for the phrase 'tasting salt.' The brain process may indeed be inferred as cause or correlate of the consciousness but the two simply are not identical.

[1] *Op. cit.*, p. 77[2]. Warren's statement is that 'our sensations . . . correspond to the physiological processes in the brain.'

[2] *Ibid.*, p. 77[1].

[3] *Ibid.*, p. 230[3]. Italics Warren's.

[4] *Op. cit.*, p. 226[2].

[5] *Ibid.*, 410[1].

[6] *Ibid.*, 402[3]. Cf. pp. 11[4], 131[1], 257[2], 436 (2).

It is difficult to understand how Warren can have made this identification in view of his earlier doctrine of the function of consciousness. For if, as now appears, sensations and ideas *are* central processes it is futile to teach that the central processes are *known through* sensations. The confusion is only thickened by Warren's designation of his theory as a '*Double-Aspect* hypothesis' of consciousness which assumes 'that conscious and neural phenomena constitute *one single series* of events.' "When they 'happen to me,'" Warren says, these events "appear as conscious experiences, when I observe them indirectly, through perceiving the behavior of other beings, by means of my senses, they appear in the form of motion, chemical change, and the like." [1] In more detail: "When," Warren says, "we are affected by a loud sound or a brilliant color we observe the phenomena in a different way from that in which we observe these forces affecting the ears or eyes of another human being. . . . Your friend's memories are observed by you only indirectly—you listen to his verbal description of them. . . . Your *own* memories are a direct and immediate part of your life." [2] This is indeed a vivid description of the distinction which we actually make between consciousness of ourselves as hearing and seeing and consciousness of gesturing bodies or of sounding voices. But this vivid description, far from showing that the "phenomena called *conscious experiences* . . . form part of the 'total description' of nerve activity," [3] not only emphasizes once more the sharp distinction between 'immediate life' and inferred neural phenomenon, but also definitely implies the conscious being, or *I*, which has these two 'ways of looking at the same set of facts.' To discuss in detail the 'double aspect theory' is, however, beside the purpose of this paper. That theory is, as Warren himself very frankly acknowledges, one hypothesis among others. He adopts it as 'the best working tool for psychological investigation,' [4] but admits that the interaction theory, also, could 'bridge the gaps in conscious

[1] *Op. cit.*, p. 415[2].
[2] *Op. cit.*, p. 9[3] f.
[3] *Op. cit.*, p. 415[3].
[4] *Op. cit.*, p. 416[1].

experience' and 'supply the missing data of brain activity.' There is reason, indeed, to suspect that Warren rejects interactionism rather through the fear—in the opinion of the writer unfounded—of its inevitably indeterministic tendency than for strictly psychological reasons. And if the suspicion turn out to be well founded it will be necessary to protest against this incursion of philosophical theorizing upon psychological description. For the double aspect hypothesis, like interactionism, is after all a metaphysical theory and the psychologist *as psychologist*, should no more be interactionist, parallelist, epiphenomenalist or upholder of the double aspect theory than he should be idealist, dualist or materialist.[1]

Upon this consideration of the basal conceptions of modified behaviorism there would naturally follow a discussion of its treatment of the specific facts of psychology. It will, however, be convenient to postpone this to the following section of this paper. The preceding pages may be very briefly summarized: Modified behaviorism, in the form which Warren gives it, while it starts out from the conception of consciousness as distinctive function of the organism, too readily identifies consciousness with neural process. With this identification, however, modified behaviorists fall back to the untenable position of the extremists, involving themselves often in metaphysical considerations beyond the scope of psychological inquiry.

III. Behaviorism as Self-psychology

The preceding sections of this paper have emphasized the crucial objections to current behavioristic psychology in both its forms. Yet it does not follow, in the view of the writer, that the cardinal principles of behaviorism must be aban-

[1] The same suspicious commerce of psychology with philosophy marks Mrs. De Laguna's interesting discussion of 'Emotion and Perception from the Behaviorist Standpoint' (Psychol. Rev., 1919, 26, 409 ff.). In her first paragraph she virtually acknowledges that her main interest in behaviorism is due to 'the importance of the philosophical advantages' which it offers. "The American neo-realists," she says, "are of peculiar interest to us" (to us behaviorists, she means) "in that they identify the act of awareness with selective activity of the nervous organism in responding to those features of the environment and body which act as stimuli." (*Op. cit.*, p. 416[1].)

doned, in other words, that psychology must give over studying the integrated individual in relation to his environment. For the criticisms of behaviorism, it is most important to observe, have been directed simply against the behaviorist's fashion of describing the relation of individual to environment. The outcome of this criticism has been in the first place (1) to show that the individual's relation to environment is not to be identified exclusively with bodily reaction, that it consists, in part at least, of consciousness; and in the second place (2) to show that consciousness is not a function strictly coördinate with bodily response, that it is in truth a more fundamental relation. These criticisms, to be sure, assail the central doctrine of behaviorism, its conception of the reacting individual if, as has always been assumed, the individual of the behaviorist must be identical with the animal body. But precisely this assumption is challenged by every psychologist who regards his science as a study of conscious self (person or mind). For the self (that which everybody means when he says 'I observe myself') is, as truly as the organism, an individual, and the self as individual is unaffected by the criticisms, just restated, of behaviorism since it is related to environment not primarily by bodily response but by consciousness. *Self-psychology*, accordingly, that is, psychology treated as science of self, is *behavioristic when it stresses the relation of self to environment.*[1] To the development of this thesis, the final division of this paper is devoted. It purposes not to re-state the reasons, many times formulated,[2] which have led to the conception of psy-

[1] It may, of course, be argued that the term 'behavioristic' should, in the interests of expediency, be abandoned to the exclusive use of the biologists. I incline to question this conclusion but am not especially concerned with the verbal dispute. This footnote offers opportunity, however, to protest against a genuine perversion of the meaning of 'behavior.' Considerations of priority and convention certainly oppose the procedure of the Clark University introspectionists who often attribute behavior to the mental processes themselves. (Cf., *e.g.*, S. C. Fisher, 'The Process of Generalizing Abstraction,' *Psychol. Monog.* No. 90, p. 92[2] *et al.* "The experience of similarity of a feature under investigation," Dr. Fisher says, ". . . consisted largely in the behavior in consciousness of the percept of the feature itself.")

[2] Cf. J. Ward, 'Psychological Principles,' Chap. II.; M. W. Calkins, 'A First Book in Psychology,' Chap. I. and Appendix, Sect. I. (with Bibliography, p. 282);

chology as study of the self, but to show that self-psychology is the science of (*a*) a behavioristically conceived individual, the self, in (*b*) behavioristically conceived relations to (*c*) a behavioristically described environment.

(*a*) To carry out this programme it is first necessary to show that the self is an individual in the behaviorist's sense of the term. Now the two basal characters of the biologist's individual, the animal organism, are the following: first (1), its integrated or *coördinated totality*, its wholeness, as contrasted alike with the elements and processes of the merely structural psychologist and with the special functions of the physiologist;[1] and second (2), *relatedness to its environment*.[2] Less emphasized but unquestionably included in the behaviorist's conception of the organism are the following characters; (3) a *relative permanence* implied in its retentiveness and plasticity, its habits and its dispositions, which Warren calls 'more or less permanent attitudes';[3] (4) *growth* or development;[4] and finally (5) *individuality*, implied particularly in the constant contrast made by Warren between 'our own mental life as each one observes it in himself' and 'mental life as observed in others.'[5]

Organized totality, relatedness to environment, persistence, changingness, individuality—these, however, are not merely characters of the human organism. For, in precisely these terms the self is described. It is certainly (1) a concrete, integrated being, a totality of varied experiences. In the words of Bertrand Russell (a Saul among the prophets) 'thoughts and feelings do not occur when there is no self for them to belong to.'[6] Both its persistence (2) and its growth

'The Self in Scientific Psychology,' *Amer. J. of Psychol.*, 1915, **26**, pp. 505 ff.; E. A. Gamble, 'A Defence of Psychology as Science of Selves,' *Psychol. Bull.*, 1915, **12**, pp. 195 ff.

[1] Cf. Watson, *op. cit.*, pp. viii, 20, 40, 48, 193[3], 209; and Warren, *op. cit.*, pp. 11[1], 92 *et al.*

[2] *Op. cit.*, p. 1. Cf. pp. 9, 20, 30[2], 92[2], 197[1]. And cf. Warren, *op. cit.*, pp. 1, 8, 10, 30 *et al.*

[3] *Op. cit.*, p. 367[4].

[4] *Ibid.*, pp. 391 ff.

[5] *Op. cit.*, p. 215[1]. Cf. pp. 9[3], 383[3], 415[2].

[6] *Scientific Method in Philosophy*, Lect. III., p. 75[1].

(3) are discovered in its recognizing and anticipating; its individuality (4) in its emotion and willing. Finally, (5) the self is, in the words of Ward, "the living subject in intercourse with his special environment."[1]

(*b*) These last words indicate that self-psychology is, in the second place, behavioristic in that it takes explicit account of the complex of objects constituting the environment. This direct contact with everyday reality is not the least of the attractions of behaviorism. In flat opposition to conventional psychology, which lavishly correlates psychic objects with physical and physiological 'stimuli' but firmly refuses to relate them to 'objects,' behaviorism insists that the psychologist must refer to the environment, physical and social, to which his integrated individual reacts. So Watson, in his introductory chapter, traces the derivation of psychology from our 'common-sense procedure' in learning to control people and to deal with situations[2] and everywhere holds that the psychologist must concern himself with the whole environment.

Once more, the self-psychologist endorses completely this behavioristic emphasis on environment. More than this, he is qualified, as the behaviorist is not, to describe in technical terms the distinctions between different sorts of objects: (1) the basal distinction, always employed but never explained by the biological behaviorists, between the impersonal 'physical' and the personal 'social' environment; (2) the distinction between the private, relatively unshared objects of imagination and the public or common shared objects of perceiving and thinking. With the details of this procedure we are not here concerned. The point at issue is simply this: that the self-psychologist has the behaviorist's conception of the environment.

(*c*) Self-psychology has finally to show that it conceives behavioristically not only self and environment but also the relation, consciousness, of self to environment. At the out-

[1] *Psychological Principles*, p. 17[2].

[2] *Op. cit.*, pp. 3–5, 7 ff. Mrs. De Laguna's attempt to endow the 'common-sense' object with such affective characters as inimicalness and hatefulness is another illustration of this fundamental behavioristic tendency. (*Op. cit.*, p. 416[1].)

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set, it is obvious that most of the biological, as distinguished from the physiological, categories of behaviorism—namely, instinctiveness, habitualness, immediacy, coördination and their opposites—are as applicable to consciousness as to bodily response. Thus, for example, fear is as instinctive as flight, and the perception of my fork is as habitual, as immediate, and as coördinated as the impulsive movement of my hand toward the fork. For the rest, the difficulty in showing that self-psychology is behavioristic in its treatment of consciousness is due mainly to the difficulty in discovering any characteristically behavioristic conception of consciousness at all. For the behaviorists, in the words of Mrs. De Laguna, have 'left . . . the classical categories of psychology—sensation, perception, emotion, affection, volition, *etc.*, . . . almost wholly to the undisputed sway of the traditional psychology.' [1] Warren, for example, devotes six chapters to a description, in structural and non-behavioristic terms, of the mental life as consisting of 'a succession of mental states.' [2] Yet Warren also suggests a truly behavioristic conception of consciousness when he introduces the conception of the attitudes which 'a man takes toward the situations which confront him.' To be sure, Warren defines the attitude, in psychophysical terms, as the subjective aspect of the 'general set'—in other words, of the 'traces which previous stimuli and impulses have left in the nerve-substance.' [3] Certainly, however, the specific attitudes which he considers are modes of behavior, reactions to environing objects. They include *interest*, described as 'our mode of receiving perceptions of the external world . . .;' [4] *desire*, 'the attitude which develops in connection with the . . . feelings,' [5] and *attention*, 'our kinæsthetic attitude.' [6] These are called primary attitudes whereas emotional dispositions and volitional proclivities are examples of what are named secondary attitudes. The difference between

[1] *Op. cit.*, p. 410[3].
[2] *Op. cit.*, Chaps. XI.–XVI., pp. 215–359. Cf. p. 354.
[3] *Op. cit.*, Chap. XVII., p. 360.
[4] *Op. cit.*, p. 362[3].
[5] *Op. cit.*, p. 363[4].
[6] *Ibid.*, p. 364[3].

belief and disbelief is also said to consist 'not in the feeling but in the *attitude* which we assume.'[1]

It is evident, at first glance, that these are attitudes of the self quite as truly as of the organism. To take Warren's examples; I, the self, even more truly than I, the body, am interested and desire and attend; have dispositions and proclivities; believe and disbelieve; am possessed of conscience and appreciation. In a word, the self-psychologist, as truly as the modified behaviorist, can describe consciousness as a complex of the attitudes of individual to environment. As a matter of fact, self-psychology, at least as far back as 1901, introduced the term '*attitudes*' to designate the varying relations of self to environment.[2] And, six years later, in Professor Judd's 'Psychology,' consciousness was systematically described in terms of 'the different attitudes which we assume toward our impressions.'[3] The detailed discussion of these doctrines of the attitude, as held by self-psychologists, would lead us too far afield. But it should certainly be stated that the more complex attitudes have been analyzed into simpler. And these more fundamental and simple attitudes include at least the following: receptivity and activity, attention directed outward or inward, and participation, or awareness of sharing the experience of other selves.[4]

[1] *Op. cit.*, p. 304^{2}.

[2] Cf. the writer's 'An Introduction to Psychology,' 1901, pp. 152^{1}, 169, 254^{2}, 270^{2}, 306^{1}. (It should be noted that in this book the meaning of 'attitude' was restricted, unjustifiably, to the relation of self to *other self*.)

[3] 'Psychology. General Introduction,' 1907, pp. 68 f., 134 f., 240, 306 f. Cf. also *J. of Phil., Psychol., &c.*, 1908, **5**, 676 ff., where Judd re-states this conception of the attitudes or 'subjective reactions' of the individual.

[4] Cf. the writer's 'A First Book in Psychology,' pp. 3, 333 f., and *passim*. Cf. also James Ward, 'Psychological Principles,' p. 57^{2} on the distinction between the 'sensory or receptive' and the 'motor or active attitude' of attention.

It may be added that the German term *Bewusstseinslage*, which Titchener translates 'attitude,' made its appearance in year 1901, also, in the first instance seemingly to designate any predominantly non-sensational and non-affective consciousness. (Cf. K. Marbe, 'Experimentell-Psychologische Untersuchungen über das Urteil,' 1901, Mayer u. Orth, 'Zur qualitativen Untersuchung der Association,' *Zeitschr. f. Psych. u. Phys. d. Sinnesorgane*, 1901, XXVI., 1 ff., and Titchener, 'Experimental Psychology of the Thought Processes,' esp. 100 ff. and 244 f.) From the first the term has suffered for lack of definition, but the examples of *Bewusstseinslagen* are clearly mental attitudes—doubt, affirmation, uncertainty, *Zwang zum Vergleichen* (Marbe, *op. cit.*, pp.

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set, it is obvious that most of the biological, as distinguished from the physiological, categories of behaviorism—namely, instinctiveness, habitualness, immediacy, coördination and their opposites—are as applicable to consciousness as to bodily response. Thus, for example, fear is as instinctive as flight, and the perception of my fork is as habitual, as immediate, and as coördinated as the impulsive movement of my hand toward the fork. For the rest, the difficulty in showing that self-psychology is behavioristic in its treatment of consciousness is due mainly to the difficulty in discovering any characteristically behavioristic conception of consciousness at all. For the behaviorists, in the words of Mrs. De Laguna, have 'left . . . the classical categories of psychology—sensation, perception, emotion, affection, volition, *etc.*, . . . almost wholly to the undisputed sway of the traditional psychology.' [1] Warren, for example, devotes six chapters to a description, in structural and non-behavioristic terms, of the mental life as consisting of 'a succession of mental states.' [2] Yet Warren also suggests a truly behavioristic conception of consciousness when he introduces the conception of the attitudes which 'a man takes toward the situations which confront him.' To be sure, Warren defines the attitude, in psychophysical terms, as the subjective aspect of the 'general set'—in other words, of the 'traces which previous stimuli and impulses have left in the nerve-substance.' [3] Certainly, however, the specific attitudes which he considers are modes of behavior, reactions to environing objects. They include *interest*, described as 'our mode of receiving perceptions of the external world . . .;' [4] *desire*, 'the attitude which develops in connection with the . . . feelings,' [5] and *attention*, 'our kinæsthetic attitude.' [6] These are called primary attitudes whereas emotional dispositions and volitional proclivities are examples of what are named secondary attitudes. The difference between

[1] *Op. cit.*, p. 410[2].
[2] *Op. cit.*, Chaps. XI.–XVI., pp. 215–359. Cf. p. 354.
[3] *Op. cit.*, Chap. XVII., p. 360.
[4] *Op. cit.*, p. 362[2].
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In this fashion the self-psychologist argues that he has the only genuine behavioristic psychology—a psychology which studies the totally integrated individual in the attitudes with which it confronts its environment. At this point, however, he is likely to be met with the complaint that self-psychology, compared with behaviorism, is, after all, as 'water unto wine,' a thin and empty substitute for what James might have called the thickness of behaviorism, its richness of content, its heaping of observation on observation. To this criticism two replies may be made. It may be pointed out in the first place that nothing forbids the incorporation in self-psychology of all the observations of the biological behaviorists. It has already been shown that mental attitudes as readily as bodily reactions may be distinguished as distinctive or acquired, habitual or novel. Furthermore, every self though it is not a human body has a body and to this body it stands in more intimate and significant relation than to any other object of its physical environment. There is accordingly no fact about instinct or habit, biologically regarded, and no phenomenon of striped or unstriped muscle, ductless gland, summation or distribution of impulse, which may not become a relevant, even if a subordinate, part of self-psychology. The self-psychologist should not, however, content himself with appropriating the riches of behaviorism biologically conceived. In the phenomena of social, differential, and abnormal psychology he has rich and, for the most part, unworked resources of his own, concrete facts of human experience indescribable except in these terms of personal relation which are the categories of a behavioristic self-psychology.

18, 30, 87, 60). Titchener, in his 'Textbook' and his 'Beginner's Psychology,' has adopted the 'mental attitude,' with seeming disregard of its behavioristic and self-psychological implications.

AN ATTEMPT TOWARD A NATURALISTIC DESCRIPTION OF EMOTIONS. (I)

BY J. R. KANTOR

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The records of recent psychological history incline us toward the view that the descriptions and theories of emotions are for the most part inspirited by the necessity to specify the precise causal connection between mental and physiological states. Thus James was interested to point out that the accepted sequential order of the mental and physiological should be reversed. What influenced James to formulate his theory was not merely the conviction that emotions are primarily organic or physical, since James was himself a subjectivist; but rather he was interested to substantiate the belief that emotions are not in any sense entitative mentalities expressing themselves in physiological action after being aroused. That the significance of James's theory lies not in the emphasis of organic resonance, but rather in the assumption that an emotion is the subsequent awareness of organic disturbances, is convincingly evidenced by the fact that the assertion of the organic basis for emotional conduct is centuries old.[1]

But now that the entire subjectivistic tradition in psychology is being challenged and tested, it seems appropriate to attempt an evaluation of emotional conduct not with regard to any causal sequence, but solely upon the basis of an observational correlation of the stimulating circumstances and the organism's responses to them. In the following discussion the writer proposes to submit a series of propositions, which it is hoped will serve to suggest an interpretation of emotional conduct from an objective and naturalistic standpoint.

[1] Cf. Titchener, E. B., 'An Historical Note on the James-Lange Theory of Emotion,' *Amer. J. of Psychol.*, **25**, 427–447.

I

The Nature of Emotional Conduct.—Emotional conduct consists of interrupting forms of action stimulated by rapidly changing circumstances, in some cases accompanied by various intense organic processes which sometimes facilitate the immediate performance of a new act.

It is absolutely important for the understanding of emotional conduct to note that the primary occurrences in such action are the confusion and excitement which disrupt the behavior ordinarily taking place when the emotion-exciting stimulus appears. When we attempt to describe the specific characteristics of an emotional act we are profoundly impressed with the condition of disrupting chaos and inhibition of action which occupies so large a place in the emotional situation. We may look upon the emotional person as practically paralyzed for a moment; he appears to undergo a dissociation of his reaction systems; so that he remains powerless and helpless until his responses are reconstituted. This reconstitution may be superficially described as a refocussing of the person toward some definite object. Essentially, emotional conduct is a momentary condition of 'no response,' since there appears to be a complete cessation of all directed responses to surrounding conditions. In point of fact, it is this disruptive chaos which definitely marks off the milder emotional activities from the numerous classes of so-called feeling behavior to which they otherwise display striking resemblance.

In detail, the 'no response' phase of the act is a natural consequence of the fact that the perceptual phase of the behavior segment cannot be followed by an overt act. In such a case the perceptual phase of the activity is an implicit response situation. When it is possible for an overt activity to occur, then there is no emotional object or condition. But whenever a dangerous object or other emotion-exciting stimulus appears, or when we meet with and recognize a dangerous situation and cannot do anything about it, we are in an emotional condition and perform an emotional response.

The emotional response, then, is not the definite functioning of an organized reaction system; in fact it is quite the opposite. In other words, we are not possessed of a large number of definite potential emotional reaction systems, in the sense that we are prepared to make specific disruptive reactions to definite objects of stimulation. In the case of various informational or habit activities, however, the organism does have definite potential response systems in its functional equipment. Thus for example, the verbal stimulus 'who was victor at Salamis?' or the perceptual presentation of the word 'loan' in stenographic notes will bring out definite overt responses which were acquired in a previous time and which are called into action by the present stimulation. Not so, however, in the case of emotional behavior in which no definite response system is functioning. What really happens to the person in the emotional situation is, that in the absence of what, from a behavioristic standpoint, may be called a required response system, the individual is thrown back upon any available behavior resources. In the most turbulent situations the person can substitute only visceral reflexes, and such behavior we may call the elemental emotions. In contrast with this condition, that is to say, in the more typically cultural situations[1] the person replaces the required response system with one serviceable in some similar circumstance (laugh when caught in a socially disapproved act, as though it were a deliberate joke), or with some response previously associated with the required act in this particular environing condition (smile profusely instead of answer question).

Assuming that we can agree that emotional behavior consists essentially of a disruptive disorganization of responses we might still question whether this diffuse and chaotic functioning of the organism offers a valid criterion of differentiation of emotional from other types of behavior. For we might recall that other types of psychological behavior also

[1] By the terms elemental and cultural the writer plans to point out a difference in behavior circumstances as illustrated by coming upon a dangerous animal in a wood and by being informed of a legacy.

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show marked reactional disturbances. In the following exposition we propose to point out that despite the apparent superficial similarities, emotional conduct presents marked behavior factors different from those of other types of psychological action.

Let us pause here to inquire briefly into the conditions responsible for the irregularities of human behavior marking the general spontaneity of all psychological activity. First, we must note that all psychological description consists primarily of all the enumerative factors comprised within the arbitrarily chosen boundaries dividing off one segment of the organism's activities from all that precedes and follows. Such a segment of behavior we may call an act, or if we choose a pattern of response. Now every such act is a product of a series of stimulating objects or conditions and response systems, some one or a few of which give a name to and characterize the act. Indispensable in the extreme for the understanding of emotional behavior at this point is the careful distinction between response systems and patterns of response. Patterns of response consist of series of definite response systems organized in contact with particular stimuli and excited to action by them. Ordinarily, the definiteness and regularity, as well as the predictability of an act, depend upon the specific correlation of a definite reaction system with some particular stimulus. Whenever the organism possesses a definite response system of some sort, capable of excitation by a specific stimulus, we may expect an orderly and more or less compact act or pattern of response. Even here the act is spontaneous and variable, provided that the context or setting of the stimulus is modifiable. This sort of situation is well illustrated by the web-spinning of spiders in which the slight modifications of the context of the stimuli makes possible the hardly perceptible differences in web-spinning. In human informational and habit modes of action a somewhat greater invariability and unconformity to type are introduced by the greater possibilities of variation in the settings of the various stimuli. Clear it is, therefore, that notwithstanding the wider or narrower latitude for irregu-

larity of behavior supplied by the variability in the setting of the stimulus, there is, of course, a fundamental describable regularity in all of our behavior which comprises organized response systems.

Here then we have a clue to the explanation why emotional conduct lacks even the remotest resemblance to order or regularity, namely the absence in such conduct of an organized reaction system. The lack of a stimulus-response integration can be more readily appreciated when we consider that the very circumstances under which emotional behavior occurs make it impossible for the person to develop response systems with which to adapt himself to those circumstances.

Moreover, this lack of a response system makes it possible to see why in the emotional situation the only basis for predicting the behavior of a person is the influence of the surroundings at the moment, and it is only because the surroundings are such as to determine the intensity of the person's dissociation, that we are able to describe, however inadequately, the comparatively large segment of behavior which includes the emotional act.

To the writer it seems that the absence of a definite response system in emotional behavior explains the following facts, and furthermore, unless there are other satisfactory means of accounting for these facts they tend to support the hypothesis that an emotional act is essentially a 'no response' phase of behavior. The facts are: (1) the impossibility of an onlooker to specify what sort of emotion a person is experiencing from any observation of the individual aside from the emotional circumstances, (2) the hitherto complete failure of psychologists to be able to make any satisfactory classification of emotional acts. (3) Furthermore, is it not the absence of a response system in emotional behavior and its replacement by reflexes which makes it easy for psychologists to misinterpret emotional acts, and to look upon them as mere bodily 'changes' or 'expressions' of invisible states of mind? (4) Again it appears that only 'no behavior' conduct could induce psychologists to interpret emotions as the awareness of organic changes or to look upon the substituted

visceral reflexes as instincts wihch protect the organism pending the arousal of the awareness of what is to be done in the situation in question. (5) And finally, the view that the same emotions are found in the animal world as in human action equipment may be traced to the fact that psychologists were observing in the human organism not definite reactions but replacement responses which do in part resemble the simple organized activities of animals.

Although the disruptive chaos may be taken as a definite mark of differentiation between emotions and other forms of behavior, it should not be considered as in any sense an exhaustive description. In the actual description of a concrete emotional situation we must include many other essential features, although chief reliance must be finally placed upon the absence of a focussed reaction system. When we thus take cognizance of all the factors in a behavior situation it becomes impossible to confuse emotional conduct with the hypnagogic dissociations in which the person is temporarily cut off from his surroundings, or with the attention shift in which there is merely an orderly reconstitution of reaction systems as a preparation for a change in behavior. To give always as full a description of behavior as possible would mean that we might avoid mistakes that now are most flagrantly indulged in, namely, calling certain acts emotions which clearly are not, such as passions, sentiments, and habits of affective response, or identifying as something else actions which are emotional in character.

Lest someone inject into the description of emotional behavior any teleological notion concerning the lack of response, we might suggest forthwith that the assumption of such a lack of a response system is based directly upon the immediate facts of the emotional situation. The fact is, that in any specific emotional situation the contextual stimuli and the associated activities that occur, clearly indicate that a particular kind of stimulus-response correlation should be a significant factor in the segment of behavior under observation. In some instances we can determine with little chance of error what the person may be expected to offer in the way of an organized and directed activity in a particular situation.

If in each case of emotional conduct the fundamental principle is the absence of a certain response system the question arises as to how to distinguish between the more and less violent emotional activities. Here as elsewhere in the investigation of emotions the only safe and sufficient guide is the consideration of the specific conditions under which the behavior occurs. As we have already pointed out the person may be found lacking a response system in a situation in which the greatest immediate need for definite action seems to dissociate him until he is left with only his simplest elementary behavior, while in other situations, events do not occur so suddenly, nor are the circumstances so pressing as to bring about even very marked surface confusion. In the milder situation there is, in fact, only a slight difference between the activity interrupted by the emotion-exciting stimulus and the resumed occupation after the emotional period is over. Consequently, the milder sorts of emotion seem to merge with the non-emotional situation in which a definite response is merely delayed or inhibited because of the person's lack of attention to a certain stimulus, or because of a momentary failure of perception.

II.

The Systematic Analysis of Emotional Acts.—As a distinctive segment of psychological activity an emotional act can not only be separated and distinguished from its preceding and succeeding contextual correlatives, but can be analyzed into its functionally constituent phases. And thus we may distinguish in the emotional situation (1) the perceptual phase, that is, the discrimination and appreciation of the stimulus object, or the ideational preliminary to an emotional response; (2) the emotional action proper; (3) the superseding organic or other activities. Succeeding these three phases we find another segment of behavior and unless it is another emotional act, involves an organized response system.

1. The perceptual phase is an act of simple apprehension which in a given case may be an implicit appreciation of a danger or its opposite. As an incipient response system a

perceptual reaction of danger involves uneasiness, excitement, trembling, and unpleasantness, all of which are reminiscent of a previous condition of the individual in actual danger, which condition is preserved and revived in vestigial form. In a sense, the perceptual phase of the emotional situation is a preparatory response for some act which is to follow. When, as sometimes happens, the exigencies of the situation prevent the occurrence of the overt act, as for example when confronted by a dangerous animal under conditions lacking available means of escape, or when an appropriate act has never been acquired for the present frustrating and baffling circumstances, then the cataclysm or seizure which is the emotional phase proper is instantaneously irrupted.

At this point it is worth noting that an emotional complex cannot include a primary perceptual act[1] as an antecedent function. For in such a case the primary differential reaction, or the meaning activity, is a directly operating overt response in the form of a definite adjustment, and therefore can never invoke a confusional, disruptive response activity, such as we find in emotional conduct.

As compared with the perceptual anticipatory phase of emotional action, the ideational antecedent of the emotional act is a more refined and more vague vestige of an original danger or other response; it is brought into operation through a substitution stimulus for the original danger situation. The statements just made presuppose an idea to be a definite act which incipiently[2] repeats a previously direct overt adjustment, or what was in a former time a precurrent or preparatory activity such as reading something, or hearing imparted information. In the case of such an antecedent act, the emotional behavior is much milder, and the organism does not as a rule get so much out of hand as in the case of the emotional situation preceded by a definite perceptual reaction. It must be understood, however, that the violence of an emotional activity is entirely due to the surrounding circum-

[1] By primary perception is meant the directly operating exteroceptive type of consummatory behavior. In primary perception the precurrent and consummatory (we borrow these terms from Sherrington) phases of activity are identical.

[2] And in many cases symbolically.

stances; so that the emotion following an ideational process might possibly be far more turbulent than one which is preceded by a perceptual activity.

2. The emotional activity proper may be described as a process of disintegration of the series of response systems constituting the individual at the moment. In effect, there is a total inhibition or suppression of all activity so far as any overt adjustmental response is concerned. Essentially, the emotional factor is a phase of behavior in which there is lacking a coördinate stimulus-response process ordinarily resulting in a definitely directed act. Such an act when it occurs may be looked upon as a consummatory response which is initiated by the precurrent perceptual or ideational action, and when this act does take place we call the pattern of response a volitional or habitual adjustment. The typical commotional seizure and chaos, is then, the direct consequence of the non-operation of a consummatory reaction when its appropriate antecedent has functioned. According to our hypothesis it appears that an emotion is intrinsically a negative form of behavior although it may serve to induce or accelerate another adjustment.

3. Because every psychological act is the reaction of an organism, it is an invariable law that whenever a stimulus fails to produce its appropriate response the organism is forced to fall back upon some substitution or replacement act. We have already suggested that in the most striking emotional situations the replacement acts are interoceptive reflexes. Hence we find an almost universal emphasis upon organic processes as prominent factors in emotional behavior. Naturally there will be a great difference in the amount and intensity of such organic activity when we compare the elemental behavior, sometimes called the violent emotions, and the cultural conduct usually referred to as the subtle or tender emotions.[1] In the latter case, it is universally true that whether the stimulus is perceptual or ideational there is always possible some measure of direct adjustment and therefore there is less organic functioning.

[1] Not sentiments or diffused feelings.

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If we accept as a fact the difference between the elemental and cultural emotions we may then specify some of the conditions in the more violent and pervasive emotional action, and assume that the descriptions will hold for the simpler activities with merely a variation in the degree of the organic components. And first we may note that the supplied organic activities involve vascular and visceral processes of all sorts. There are disturbances of the digestive secretions, respiration, contraction of blood vessels, acceleration or retardation of the heart beat, induction of various secretions, etc. Very frequently we find also as substitutes for definite focussed responses, imperfectly articulate cries which in most cases answer better to the description of groans or screams than to language. Still other substituted actions are the numerous random activities of the skeletal muscles sometimes becoming so exaggerated in emotional behavior that persons assume poses of cataleptic rigidity.

Following very closely upon the emotional activity proper the person may begin an act which is directly conditioned by the stimulating circumstances surrounding him at the moment. Naturally the type of response will depend upon the circumstances which initiated the emotional activity in the first place, since we are here observing what is after all a definite and restricted event. In the case of a primary emotion the activities are large overt responses involving the external skeletal muscles, as in fighting, running, and jumping. It is in such cases that the preceding definite emotional conditions may be of service. In the secondary emotional situations the transition from the state of suspense and confusion is more gradual and in fact the whole emotional situation is more of a piece with other activities than is true in the primary emotions. In other words, the specific emotional action is decidedly less marked off from preceding and succeeding segments of behavior. The directed responses following an emotional situation are then very rigidly determined by the surrounding stimulating objects and in all types of emotional conduct are at first diffuse and not especially well directed for the needs at hand. The recovery is indefinitely more rapid,

however, for the cultural emotions, since as we have already seen, in these cases the organism is never shaken to the reaction foundations. In all cases, however, it must be noted that when the final activity once begins the emotional action proper has ceased to exist. This directed act or adjustment must be considered as a consummatory act following a precurrent response which is not identical with the anticipatory phase of the emotional act. It is, therefore, from the standpoint of the stimulus, a new and not merely a delayed reaction. So disparate are the emotional acts and the adjustments which follow them that in any given emotional situation the presentation of a new stimulus, no matter how remote from the emotional situation, will strikingly curtail the emotion. Such a situation is well illustrated by the student suffering an emotional confusion while being orally examined, but who recovers immediately when he attempts to make some reply, however unsuited to the question.

III

Some Points of Contact between the Organismic[1] *Hypothesis and the James-Lange Theory.*—Our analysis of emotional conduct suggests a basis for reëxamining some of the discussions centering about James's formulations of emotions. One of the essential points in the discussion turns about the problem of harmonizing the directness and immediacy of emotional conduct with the apparently necessary cognition of what sort of act should occur. The pre-Jamesian view was interpreted in the following manner. The stimulus object excites a mental state (emotion) which is followed by its appropriate bodily expression. Not unlike his predecessors James was a mentalist, and consequently thought of an emotion as a 'state of mind,' but he saw clearly the necessity of connecting it very closely with overt activities if the description was to be at all in consonance with the facts. As a result, James was lead to assert that the emotion proper follows the bodily

[1] By the term organismic we mean to point out the absolute inseparability of the factors in an emotional or any other psychological act. Emotions as acts of a unique individual cannot be thought of as composed of parallel or interacting parts.

expression. Now, although we must admit that James's emphasis of the immediate occurrence of some act was a distinct stage in advance of his predecessors' theory, yet because he thought of an emotion as the knowledge process in the situation he could not explain why any particular behavior or expression, as he called it, should be connected with any specific mental state. The solution that he offered was that the stimulus object calls out an instinct act presumably appropriate for the occasion, and which supplies the characteristic emotional tone to the succeeding mental state.

Such a solution could of course not be satisfactory to James himself unless he could conceive of an instinct as a definite cognitive activity, a condition which runs completely counter to James's mentalistic attitude and his own vivid description of instincts as primarily physiological processes. For unless he could consider instincts to be definite cognitive processes, the fact that different kinds of acts seem to be associated with any given emotion still leaves the original problem on his hands. But if the instinct is a cognitive act what purpose can the succeeding mental state serve, since the reflex-instinct act arrogates its function? It is not surprising, therefore, that James soon gave up the notion of the instinct as the means of connecting an immediate overt act with an emotion, in favor of the idea that possibly there are differentiations in organic activities suitable enough to provide specific antecedents to the mental phases of emotions.

How differently interpreted is the entire behavior situation from an objective standpoint. Whatever the immediate act may be, its prompt occurrence following the perception of the stimulating object is a natural consequence of the phasic character of all psychological behavior, for perception is merely a precurrent phase of a segment of behavior in which some consummatory reaction is to follow.[1] And since the precurrent action is a perceptual process, no inscrutably working instinct need be here invoked. As we have attempted to show in the earlier part of this paper, it happens

[1] Cf. Kantor, 'Suggestions Toward a Scientific Interpretation of Perception,' PSYCHOL. REV., 1920, 27, 191 ff.

that in a segment of emotional behavior no organized response actually occurs, but instead a series of replacement reflexes. It is of course understood that each phase of any segment of behavior is the reaction of the complete organism as a biological unit. Unless one adopts an organismic hypothesis at this point, it is impossible to avoid a controversy, as the experience of James illustrates, concerning the order of emotional events.

If it is true as we have suggested, that the perceptual phase of a segment of emotional behavior brings about a 'no response' action, what becomes of the knowledge factor that seems so essential to James in common with all other writers on the emotions? Our answer to this question is as follows. In the first place, since no directed adaptation follows the perceptual phase of the segment of emotional behavior we are not obliged to assume that the precurrent perceptual response carries any further significance than the appreciation of a danger or other stimulus. And further, any definite knowledge of what is occurring in the emotional situation is a cognitional response belonging to a segment of behavior postdating the emotional situation in question. To us it seems that most of the difficulty that James had with the emotions arose from a confusion of the perceptual phase of an emotional situation with the knowledge of an emotional event after it occurs.

We believe that an objective analysis of emotional conduct reveals two kinds of cognitive factors. The first is the precurrent appreciation of an emotion-exciting object which results in a 'no response' action with substituted organic reflexes. The second is the self-expressive language act which we may call the overt appreciation of the danger situation. We repeat, that if James could have kept these two distinct and considered them as phases of a complex action, he could have obviated the entity interpretation while still doing full justice to the conception of emotions as rapidly occurring acts in which running or striking follow directly upon the perception of some stimulating object.

Another essential feature of the Jamesian theory of emo-

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tions, which becomes clarified by our organismic hypothesis, is the shift which we have intimated James effected in the expressions of the emotions. Let us recall that in the 'Principles' he mentioned as antecedent expressions such overt directed responses as crying, running, and striking, and that in the 'recantation of heresy' article[1] he modified his view to stress visceral activities. This shift was stimulated by the critics of his theory who pointed out that entirely different expressions might give rise to the same emotions,[2] and bespoke an endeavor to find less inflexible touchstones of his theory. In supplanting the exteroceptive activities with diffuse interoceptive waves as expressions of emotions, James of course weakened his theory, since he gave up what appeared to be prime prerequisites to support the denial of the antecedent mental factor in emotions.[3] James's acquiescence in what was virtually a complete retreat from his original position, was inevitable as long as he did not recognize that the factors in an emotional act are a succession of organismic responses, and not sequences of mental and physical events.

Could James have developed an organismic conception from which both antecedent and consequent mentalities are banished, he might readily have seen that the overt directed acts such as running or striking are very immediately related to the emotional situation, but need not be interpreted as concomitants of mental states. As our analysis has indicated, these overt responses are consummatory phases of behavior following very closely upon the preparatory perceptual reaction which postdates the emotional phase of another segment of behavior. In point of fact, when these running or striking acts occur, even when they seem simultaneous with the appearance of the emotion-exciting stimulus, the emotional seizure is over.

And finally, the organismic hypothesis affords us an insight into the fallacy of making emotions consist to a very considerable degree of organic activities. Had James not

[1] Psychol. Rev., 1894, 1, 516.

[2] Cf. Worcester, *Monist*, 3, 285 ff.

[3] Especially was this true, since as James himself realized, different organic activities may belong to the same emotions, Cf. Psychol. Rev., 1894, 1, 520.

been a subjectivist he would never have faced the necessity of making the organic processes into positive, adaptive responses which serve to express emotions. Rather he would have seen why the organic processes must inevitably be indifferent 'expressions' of emotions. Could James have seen that the organic processes are merely substitute activities which fill in a gap between two anticipatory or precurrent reactions, the former of which is not followed by an appropriate final act, he would have realized that these organic reactions could not be 'expressions' of specific 'emotions,' whether preceding or succeeding them. Failing to evaluate properly the organic resonances, James found in them nothing but an illusion of immediacy.

IV

Distinction of Emotions from Non-Emotional Feeling Behavior.—The strict observation of actual responses under different conditions of stimulation indicates very clearly that a wide difference exists between the disruptive types of emotional action and other forms of feeling behavior which are frequently called by the same name. Probably few accomplishments in psychology are more desirable than the isolation and examination of the distinguishing features of the great mass of activities which have been indiscriminately thrown into a heap through the intellectualistic influence of subjectivistic psychology. Let us note that the necessity to review the facts of affective behavior is intimately bound up with a naturalistic attitude. In the first place, not until such an attitude became at all established was it deemed necessary to give much attention to the detailed analysis of human behavior. Again, this naturalistic view is of extreme advantage for the study of feeling behavior, since it serves to prevent our being misled by the conception of a presumed operation in them of some form of common mental content symbolized by a word such as Fear or Anger.

In reply to the question whether there is any feature of behavior which sharply marks off the emotions from other kinds of feeling conduct, we may offer the tentative criterion

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of the presence or absence in the act of an organized response system. If this criterion be valid and if it be employed as a guide in the investigation of human activity, we ought to be able, not only to distinguish emotions from all other feeling behavior as a class, but also from each type of activity in the class.

Especially is it necessary to mark off sharply the emotions from the passions, which constitute a very different form of behavior. Unlike the emotions, the passions consist of organized response systems which in some form operate continuously, whether or not the original stimulating object is present. The passions, as exemplified by love and hate, are the prolonged functioning of organized response systems kept active by the periodic appearance of the original stimulus or by some substituted stimulus-object such as a letter or some other token. Moreover, between the intervals of direct or substituted stimulation by the original object of love or hate, the person is constantly responding in a characteristic feeling manner, thereby inducing much self-stimulation. Thus, a person who acquires a passion for another individual or some object such as books or music, begins to respond with some form of implicit feeling activity, becoming cheerful, hopeful, happy or enthusiastic, depending upon the specific circumstances.[1] Clearly, when we observe the person responding to the absent object of passion; that is, when he responds with the protracted implicit feeling activity, we cannot possibly confuse such behavior with the momentarily explosive emotional reaction. On the other hand, when we compare with an emotion the more violent focussed passion responses performed in the presence of the stimulating objects, probably the only crucial criterion is that the passion acts do, and the emotional acts do not involve definite organized reaction systems. However unsatisfactory the description of passion acts may be at the present time, it is beyond doubt

[1] The extreme importance of the situation to which responses are made is well brought out in these activities; also we observe the intermingling of different forms of feeling reaction in the same segment of behavior. Especially do we find considerable alternation between emotions and diffuse feelings.

that they constitute a genuine chapter in the psychology of feeling.

Also the emotions must be clearly distinguished from the sentiments which are in essence prescriptive and limiting types of activity developed under the influence of social approval. Sentiment acts are directed forms of responses usually resulting in some definite kind of complex social conduct. Illustrative of the sentiments are the activities of modesty, cleanliness, and charitableness. A sentiment is a preferred act of acquiescence or readiness to do certain definite complex things or to have them done. Again, sentiments are in a genuine sense latent and intermittent responses and the specific acts may involve much implicit or thought activity. As compared with sentiments, passions are for the largest part direct and specific responses to stimuli; passion acts being more elemental and explicit, they are also more closely integrated with the immediate surrounding conditions, while sentiments are more generalized reaction systems having a larger range of exciting stimuli.

Unfortunate indeed is the confusion of emotional conduct with diffuse feeling behavior, a practice generously indulged in when the term emotions is employed as a general blanket for all sorts of feeling activity. The diffused feeling acts are responses to prolonged conditions as of desire, achievement, or thwartedness. They are responses to objects and conditions definitely recognized as of a particular character, beautiful, good, wise, etc. Upon the basis of definite external situations in which the person finds himself we can trace out particular forms of responses that may be denoted regretful, remorseful, relief, elation, cheerful, enthusiastic, disappointed, admiring, patient, or impatient, happy, excited, shocked, depressed, and an indefinite number of others. In all these cases there are more or less continued effects brought about in a person through some contact with particular objects in specific settings. In each case it appears that the whole individual is involved, and for a considerable period of time; so that any particular feeling is distributed over all the reaction patterns of the person. In worry, for example, the individual seems

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overwhelmed by a certain environing condition and constantly keeps up a process of self-stimulation, thereby reinforcing the feeling. We find also the constant tendency to hark back to the feeling stimulus as a point of reference. Thus when we are worried about an impending calamity and read of someone's success, we connect ourselves with that situation and feel deeper concerning our own affair. In a general way, the diffuse feelings are implicit phases of all the activities of the person while he is in an affective condition.

Since the diffuse feelings are not outwardly directed, the definite response systems of such behavior are not always manifest to the observer; so that it may not be entirely out of the way to say that in intense feeling one is simply acting upon oneself. As a consequence, to a considerable extent we may think of diffuse feelings as conditioning activities, in the sense that while they are operating they will affect any activity the person is performing.

Great as are the difficulties of description encountered in even the slightest penetration into the maze of feeling responses, they can be amply accounted for by the lack of exploration in the psychology of feelings. The absence of accurate investigations in this domain is manifested by the fact that the interpretation of feeling conduct is based less upon facts of concrete reactions than upon the habits of popular speech. The futility of such interpretation is clear when we consider that no feeling term in popular use refers to a type of response belonging exclusively to a single class of psychological reaction. But although we have yet to begin the isolation of the various classes of feeling behavior, the differentiation of emotional conduct from the various other forms of feeling behavior appears plausible and worth while.

V

Are Emotions Inherited?—The conception of emotions as inherited forms of response is a legacy which psychology has acquired from the tradition of biological abstractionism.[1]

[1] Cf. Kantor, 'A Functional Interpretation of Human Instincts,' Psychol. Rev., 1920, 27, 55.

Immediately we face the question as to *what* is inherited and *how*. From the standpoint of a mental states psychology, one might say, of course, that a permanent state of mind may be inherited, but what bearing can such an assertion have upon the problems of objective psychology? When we confine our study to definite facts of behavior and reject the conception of emotion-cause and its manifestations, we find no specific kind of chaotic condition as a permanent acquisition of the person, arousable to action by various sorts of stimulating objects or conditions. Some there are who might say that the inheritance of emotions means that the individual is so constituted that he will suffer dissociation when put under certain kinds of stress, but how informing is this statement? Such a statement is on a par with the assertion that the human individual is born to think, to perceive, to wear clothes, as well as to undergo various other experiences.

The doctrine of diuturnal inheritable emotions must inevitably make emotions into entities of some sort. For, consider that the doctrine requires nothing less than that a person should be equipped with some innate powers manifesting themselves in complex and peculiar activities in emotional situations. Not the least objectionable consequence of the entity interpretation is that it implies a parallelism or an interactionism, and this circumstance always means an obscuring of the actual events in human behavior. An emotion comes to be either a cause, an effect or an accompaniment of bodily activities.

That much of the writing concerning emotions is based on an entitative conception is amply demonstrated by the psychological literature relative to the organization, combination and association of emotions. Thus, from the time of Descartes to the present, there is an unbroken procession of theories as to how a few primary or simple emotions (states or entities) become combined into complex emotions or sentiments. The only difference between a seventeenth century mixture and a twentieth century compounding of emotional states lies in the connection of the emotion in the latter case with an instinct which is presumed to be in some sense a

biological process.[1] In actual practice, however, there is little difference between Descartes' organization of all emotions (passions) he enumerates forty from the six primaries (admiration, love, hatred, desire, joy, and sadness) and Spinoza's combination of all (about forty-six)[2] from the three primaries (desire, pleasure, and pain) or McDougall's, Shand's and Ribot's association of elementary emotional states into complex sentiments. In all cases there is a logical grouping of elements which are apparently derived from an analysis of feeling situations[3] quite after the fashion of the British associationists. In no case is there, nor indeed can there be any attempt to connect such combinations of emotions with any directly observable data of behavior.

At the basis of all intellectualistic attempts to describe and compound emotions lies the assumption explicit or implied that the psychologist is attempting to describe the ultimate character of human nature and not the concrete behavior of a human organism under its various conditions of stimulation. This assumption of the ultimacy of human nature further implies that emotional states constitute some of the prominent factors of human nature. Here is a suggestion as to the motive for assuming the inheritability and permanence of emotions, namely, a prejudice concerning the absolutistic and invariable character of psychological facts. The domain of psychology appears to be the final halting place for those finalities which, since the Renaissance, have been gradually ousted from the natural sciences. Instead of describing emotional behavior, as indeed all other phenomena of the psychological domain, as definite organismic responses to specific stimulating circumstances, the attempt is made to describe behavior as manifestations of putative powers, or substances resident in the individual. In consequence, the names of emotions, as well as other classes of behavior are hypostatized

[1] We use the term biological process here because, while even in Spinoza we find a reference of emotions to biological conditions, such reference does not involve specific modern physiological details.

[2] I adopt Ribot's calculations here.

[3] "We may count as primitive all those which cannot be reduced to previous manifestations." Ribot, 'Psychology of the Emotions,' p. 13.

into unique qualities of mind. The subjectivistic psychologist of emotions treats the behavior he studies much after the fashion in which the older ethicist handled the social activities he dealt with, and so fear, love and anger became 'properties' of the individual in a manner similar to that of the 'virtues.'

If anything can be clearly made out in the observation and description of emotional behavior it is this: that such behavior only occurs under definite, external surrounding conditions and therefore can only be described in terms of such conditions. The specific movements of and changes in the individual are direct effects of definite external circumstances and not expressions of innate and continuous entities. This fact is, of course, no more true for emotions than for any other sort of behavior, but it requires special mention here, because the tradition has grown up that emotions are peculiar forces or tendencies which manifest themselves in many singular ways. This is in effect making emotions or the instincts which are presumed to operate with them into final causes or primary principles of behavior of which the various activities of the human individual are the effects.

Excellently illustrative of this attitude is the reiterated assertion that love in all its forms, including all the acts referred to under this term, is the manifestation of a hidden force called the sexual instinct. This sex-love situation admittedly constitutes a crucial instance because of the pervasiveness of sex behavior, but a critical examination of the facts involved offers sufficient evidence that every specific activity which we find in this series of behavior segments can be described without invoking any transexperiential causative factor. The wide prevalence and constant occurrence of certain forms of behavior can be readily accounted for on the basis of incessant stimulation. Consequently, it would be very remarkable if there existed less sex activity in the form of actual sex behavior and discussion than we now find in the presence of all the multifarious sex stimulations, both social and physiological, constantly surrounding us.

Among the conditions unwittingly designed to induce sex

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stimulation are the divergent apparel, work, duties, virtues of men and women, which have developed with an uncanny inclination towards the emphasis of sexual differences. Moreover, modern civilization has tended more and more to make of woman a sex object, a stimulus to sex reaction. Possibly the reader will find just here a justification of the belief that a sex instinct-emotion is responsible for such social development as we have suggested; but is it of advantage to psychology, we might ask, to compromise our interpretations with a hopeless bias of immutable final causes, in view of the fact that we can readily convince ourselves of the existence of definite empirical facts to account for the kind of society that we have developed? Any critical investigation of differential phases of civilization as represented by different geographical, national and temporal conditions, will disclose sufficient economic, social, and religious motives, in short, verifiable conditions, to account for the peculiarities of our complex social behavior.

And now we must consider the biological facts of sex, those most potent sources of confusion in psychological investigations. Because the biological factors which condition psychological reactions are so imperious in their influence and so constant in their operation they have been repeatedly misinterpreted. Instead of being described as essential factors in organismic reactions they have been made into vital forces or purposes. Now obviously the biological organization of the person as the pre-psychological matrix of all human behavior, exerts great influence upon his conduct, but just as obvious it is that the biological sex factors are simple stimulus-response activities. To consider the comparatively simple biochemical processes which operate as components in psychological reactions as causes or representatives of vital causes is to do violence to critical observation. Furthermore, it is not incorrect to say that the biological factors of sex, at the level of human psychological development, serve as subordinate influences of behavior among the exceedingly many others. Are we beyond understanding how physiological sex activity can be secondary excitements to

behavior originally induced by primary social sex stimulation? And what of the numerous sex-gland and other reflexes which serve as important stimuli to sex behavior, both implicit and overt? Are these reflexes to be interpreted as anything but natural consequences of the metabolic conditions of the individual at the time? For if they are the results of such definite physiological processes, and who can doubt the fact, then they are, of course, the effects of immediately occurring and verifiable biological processes, and not the manifestations of mysterious instincts. Most infelicitous is the confusion of the directly observable biological processes stimulating us to action, precisely as the other conditions about us do, with hidden forces which have no actual existence aside from their name. Must we not conclude then, that the biological factors of sex, in the form of sex structures and their functions, merely provide a foundation and a means for the operation of sex behavior, while the sex reflexes serve only as concrete stimuli for various kinds of reactions?

To believe that all the complex human sex actions are the manifestations of a sex-instinct-emotion is like attributing the standing-up reactions of a child to an upright instinct, although in the latter case only the slightest amount of critical observation makes it easy to see that it is not because he has a standing-up instinct that the child is induced to acquire standing-up reactions, but because in addition to his peculiar biological structure he is living in a standing-up world. All the objects and their settings are standing-up objects and it would be really impossible for the child to develop otherwise. Here as elsewhere, of course, one can invoke an absolute teleological factor and say that an ultimate cosmic purpose has brought it about that the child should be born into a standing-up world. The writer frankly admits that to such an argument he lacks all answer.

If we have succeeded in making it at all plausible that the intricate emotional and feeling behavior of a sex character is to be interpreted primarily, if not exclusively, in terms of definite surrounding circumstances, it must appear that the same situation would be true in the case of other feeling

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behavior such as anger, grief, and fear. In each case, the specific phases of the behavior event can be correlated with a stimulating object or condition. The names given to the events denote concretely occurring phenomena and not ends which are being worked out through pre-arranged machinery. Unfortunately psychologists have been in the habit of considering emotional responses as innate feeling activities much after the fashion in which they have thought of instincts as innate knowledge processes. And this condition prevails in spite of the fact that every observation of fear or anger behavior strongly suggests that no matter what action occurs, it is a direct function, in a mathematical sense, of changes that are taking place in the environment of the individual. What is more natural than that one should attempt to strike back when struck, and when this is prevented by holding the hands it is to be expected that the person will kick, cry, and attempt other means of releasing himself and doing damage to his opponent. This whole activity may be called an anger stimulus and response situation, but in no sense must we speak of the striking out, the breath holding, the snarling and the crying as 'emotional manifestations' of an anger 'emotion.' Can there be any other explanation than that the variable and unpredictable occurrences in an emotional situation are the results of series of specific external stimulations? As to the name of the total behavior when the name stands for an actual emotion, is not that derived from the mere fact that it includes an emotional factor, although that factor is of the briefest duration. For the most part, however, the actions taking place in the total situation can be analyzed into volitions, habits, perceptual responses, etc. Do psychologists mean by an 'emotion' anything more than some event hypostatized through the medium of a name?

(To be concluded.)

THE AFFECTIVE TONE OF LINES: EXPERIMENTAL RESEARCHES[1]

BY HELGE LUNDHOLM

Literature about Art very often gives us descriptions of masterpieces, wherein pure lines are characterized by adjectives that indicate a more or less emotional quality. Thus authors used to write about melancholy lines in paintings by Perugino, quiet lines in certain classical schools, violent lines in the barocque art, etc. Out of these facts there arises a problem. Is the affective character of the line a quality which is bound to the line itself, or is it suggested by the literary subject of the masterpiece? Furthermore, is this quality a phenomenon that appears equally to different observers? In order to throw light upon these questions, the following experiments were undertaken. The procedure was very simple. The persons who acted as subjects were asked to draw lines, each of which was to express the affective tone of an adjective given verbally. In the first series 48 adjectives, divided into 13 groups of synonyms, were used as follows:

I. Sad, melancholy, mournful, doleful, sorrowful.
II. Quiet, calm, tranquil, serene.
III. Lazy, indolent, idle.
IV. Merry, cheerful, gay, jolly, joyous.
V. Agitating, exciting, sprightly, fiery, brisk, vivacious, lively.
VI. Furious, angry, cross, vexed, enraged.
VII. Dead, dull.
VIII. Playful.
IX. Weak, feeble, faint, delicate.
X. Gentle, mild.
XI. Hard, harsh, cruel.
XII. Serious, solemn, grave, earnest.
XIII. Powerful, forceful, strong.

[1] From the Psychological Laboratory of Harvard University, 1919–1920.

Two other series followed: the first of these was to find out if certain lines, so to speak, accord with certain colors; the second to learn what is characteristic of purely beautiful lines. The adjectives of these series were:

XIV. Red, blue.

XV. Beautiful, ugly.

Each line was drawn with a pencil on a sheet of white paper, 21 × 27 cm. in size. The greatest liberty was allowed the subjects even with regard to the time used in drawing the lines. The manner of moving the hand and pencil while drawing was carefully observed and described in each individual case. No record was taken either of the pressure of the pencil or of the time used in drawing each line. The series were repeated, the only change in the instruction being that the line should be drawn as rapidly as possible. The first and second line of each type were compared and if they differed the subject was requested to draw a new one, after which he decided which of the lines most satisfactorily expressed the purport of the adjective in question. It sometimes happened in the first series, that a subject drew several lines of one and the same type as if for trial. In those cases too they decided themselves which line satisfied them most fully. In tabulating the results only one line of each type was used and then always the one which had been judged most expressive.

The subjects were requested to express the adjective as far as possible by a pure line, not to symbolize sadness by the curve of a melancholy mouth or strength by a line suggesting the contour of a rock-formation, etc. Yet they were earnestly instructed to mention associations of this nature. Furthermore they were requested to describe the relation of every synonym to the first adjective in the group, in order that the experimentor might know what meaning the subject attached to the various adjectives. The introspection was carefully noted, and as far as possible verbatim. The sequence of the lines was such that two lines belonging to the same group never followed each other and were very seldom drawn in the same period.

The subjects were eight in number: four women, G, L, Mi, S; and four men, C, D, F and Ma. No one of them was either painter, or designer, nor did they know anything about the theories of the æsthetics of lines.

The experimentation took place from October 1919 to May 1920 in the Psychological Laboratory of Harvard University.

When the experiments were finished an examination of the results revealed certain principles by which the lines with a few exceptions could be classified. Thus they could first be separated into the following groups:

I. Lines with only curves.
II. Lines with only angles.
III. Lines with both angles and curves.

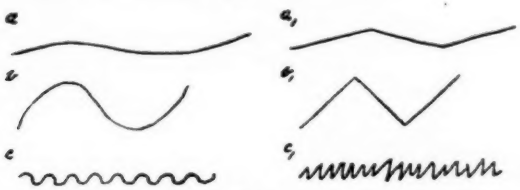

FIG. 1.

The first group (I) could in turn be divided into three subdivisions:

(1) Lines with a few long and low waves (Fig. 1, *a*).
(2) Lines with a few high waves of medium length (Fig. 1, *b*).
(3) Lines with numerous small waves of varying shape (Fig. 1, *c*).

Correspondingly the second group (II) could be subdivided into:

(1) Lines with a few obtuse angles (Fig. 1, a_1).
(2) Lines with a few approximate right angles (Fig. 1, b_1).
(3) Lines with numerous acute angles (Fig. 1, c_1).

Finally the third group (III) could be subdivided according to the way in which waves of type *a*, *b*, and *c* were present in combination with angles of type a_1, b_1, and c_1.

Another point of view from which the lines could be classified was that concerning their general direction. They

were supposed to be drawn horizontally from left to right in the largest dimension of the paper. Nevertheless in some of them there was a marked tendency to run upwards, in others a tendency to run downwards. These two together with the horizontal direction gives us three more groups.

It is self-evident that a classification of such a great number of lines as the experiments produced, must always be, to a certain extent, approximate. As has already been said the small waves were very often of a varying shape, and this variation grew still greater when they occurred in combination with angles. The latter in turn, especially acute angles, also showed very varying forms. Likewise there were found intermediate forms which were placed in the system according to the degree with which they approached the main types. It was easier to group those lines which had long and low waves and obtuse angles. Waves of type *a* very seldom occurred together with waves of type *c* in one and the same line. In a few cases waves of the latter type were found mixed with those of type *b*. In such cases the lines were placed within sub-group (2) or (3) according to the frequency of the different waves. Quite analogous was the situation regarding the occurrence of angles of the types a_1, b_1, and c_1.

The long and low waves and the waves of medium length were very few in number in each line, as a rule there were only $1\frac{1}{2}$ or 2 of them; while the small waves were numerous, in most cases 15 or 20. In the same way the obtuse and right angles always occurred less frequently than the acute ones. Sometimes small waves and acute angles were found as a secondary oscillation of a long wave or of a wave of medium length. This was often the case when the main direction of a line had an upward or downward tendency. Since in such cases the introspection did not attribute any other importance to the main wave than that of indicating upward or downward movement, these lines were always grouped under the type of small waves and acute angles.

On the following pages the lines are tabulated according to the two points of view mentioned. The headings of the

TABLE I.

	A			*C*			*A* and *C*						*Di*		
							A			*C*					
	B	*M*	*S*	*B*	*M*	*S*	*B*	*M*	*S*	*B*	*M*	*S*	*H*	*U*	*D*
I.															
(*a*) Sad				7	1								2		6
(*b*) Melancholy				7	1								1		7
(*c*) Mournful				6	1	1							1		7
(*d*) Doleful				5	1				2				1		6 11
(*e*) Sorrowful				7		1								1	7
Total				32	4	2			2			2	5	1	33
II.															
(*a*) Quiet				8									7		1
(*b*) Calm				8									5		3
(*c*) Tranquil				8									6	1	1
(*d*) Serene				8									8		
Total				32									26	1	5
III.															
(*a*) Lazy				8									1		7
(*b*) Indolent				7	1								3		5
(*c*) Idle				7									3	1	3 C°
Total				22	1								7	1	15
IV.															
(*a*) Merry						6			2		2		4	4	
(*b*) Cheerful				2	1	3		1	1	1	1		3	5	
(*c*) Gay					1	5	1		1	1	1		3	5	
(*d*) Jolly					3	3			2		2		5	3	
(*e*) Joyous				1	2	3			2		2		1	6	1
Total				3	7	20	1	1	8	2	8		16	23	1
V.															
(*a*) Agitating		3							5		5		4	2	2
(*b*) Exciting				1		2			5		5		3	5	
(*c*) Sprightly						2			6		6		7	1	
(*d*) Fiery		3							5		5		5	2	1
(*e*) Brisk		2						1	5	1	5		4	4	
(*f*) Vivacious					1				6	1	5		2	6	Ma
(*g*) Lively									7	1	6		4	3	1 Ma
Total		8		1	1	4		1	39	3	37		29	23	4
VI.															
(*a*) Furious			2						6		1	5	4	3	1
(*b*) Angry			1						6			6	4	2	1 S
(*c*) Cross			2	1					4		1	3	3	2	2 G°
(*d*) Vexed			2				1	1	4		1	5	3	4	
(*e*) Enraged			1			1			5			5	3	4	1 D
Total			8	1		1	1	1	25		3	24	17	15	5

	A			*C*			*A* and *C*						*Di*		
							A			*C*					
	B	*M*	*S*	*B*	*M*	*S*	*B*	*M*	*S*	*B*	*M*	*S*	*H*	*U*	*D*
VII.															
(*a*) Dead.....		1		5									7		1 D.L.
(*b*) Dull.....	1			6									5		3 D.
Total.....	1	1		11									12		4
VIII.															
(*a*) Playful.....					1	2			4			4	3	4	1 S
IX.															
(*a*) Weak.....				4		4							3		5
(*b*) Feeble.....				3									3	1	4 Mi, L, C, G, Ma.
(*c*) Faint.....				5	1								3		5 S.F.
(*d*) Delicate....				1	1	4			1			1	5	2	1 Ma.
Total.....				13	2	8			1			1	14	3	15
X.															
(*a*) Gentle.....				7		1							5		3
(*b*) Mild.....				5	1	1							7		1 Ma
Total.....				12	1	2							12		4
XI.															
(*a*) Hard.....	1	5	2										6	1	1
(*b*) Harsh.....			4						4		1	3	3	1	2 Ma, S.
(*c*) Cruel.....		1	5		1				1			1	4	2	2
Total.....	1	6	11		1				5		1	4	13	4	5
XII.															
(*a*) Serious.....				5	3								4	1	3
(*b*) Solemn.....				6		1							5		3 Ma
(*c*) Grave.....				6	2								3	1	4
(*d*) Earnest.....				5	1									4	4 S Ma
Total.....				22	6	1							12	6	14
XIII.															
(*a*) Powerful....		1		3	4								5	3	
(*b*) Forceful....	1	2	1	2	1				1			1	3	4	1
(*c*) Strong.....		2		1	4	1							1	5	2
Total.....	1	5	1	6	9	1			1			1	9	12	3

columns mean: (*A*) angles, and (*C*) curves, (*B*), (*M*), and (*S*), big, medium, small, referring respectively to waves of the types Fig. 1, *a*, *b*, and *c*, and angles of the types Fig. 1, a_1, b_1, and c_1. (*Di*) means chief direction, (*H*), (*U*), and (*D*), horizontal, upward tendency and downward tendency. On

the right side of each table are indicated lines which for one reason or another are outside of the groups. The letters at the right indicate the subjects who draw those unclassified lines, while the horizontal line in which they stand indicate the type of the line (sad, joyous, etc.). A letter with index ° means that the line was not drawn by the subject.

Table II. shows how the lines are divided if each group of synonyms is taken as a whole. The numbers are reduced to a per cent. of the total number, within the group.

TABLE II.

	A			C			A and C						Di			
							A			C						
	B	M	S	B	M	S	B	M	S	B	M	S	H	U	D	
I. Sad, etc.				82	10	5			3			3	13	3	84	
II. Quiet, etc.				100									81	3	16	
III. Lazy, etc.				92									29	4	63	4
IV. Merry, etc.				8.4	18	50	2	2	20		4	20	40	58	2	
V. Agitating, etc.			14	2	2	7		2	70		5	67	52	41	7	3
VI. Furious, etc.			21	2.5		2.5	2.5	2.5	64		8	61	44	38	13	5
VII. Dead, etc.	6	6		69									75		25	19
VIII. Playful					13	26			50			50	38	50	12	11
IX. Weak, etc.				41	6	25			3			3	44	9	47	25
X. Gentle, etc.				75	6	13							75		25	6
XI. Hard, etc.	4	25	46		4				21		4	17	54	17	21	8
XII. Serious, etc.				69	19	3							38	18	44	9
XIII. Powerful, etc.	4	21	4	25	38	4			4			4	37	50	13	

If, to begin with, we look over the first six groups in the tables we find that in group I.–III. (sad, quiet, lazy, etc.) most of the lines show curves of type *a*, *i.e.*, 82 per cent., 100 per cent. and 92 per cent., while the number of lines drawn with small curves, and with angles and curves is very inconsiderable. In the groups IV.–VI. (merry, agitating, furious, etc.), which contain adjectives indicating to a certain extent opposite mental states, the contrary is true, that is, a very great number of lines show short waves and acute angles while waves of types *a* and *b*, and angles of a_1 and b_1, are a decided minority. It is also striking that in Group IV. (merry, etc.) lines with only short waves of type *c* predominate and that in Group V. (agitating, etc.) we meet for the first time lines with only angles, and those all of type c_1.

Hence we find a relative uniformity in the lines belonging to groups I.–III. (sad, quiet, lazy, etc.) as well as a certain uniformity in the lines of groups IV.–VI.(merry, agitating, furious, etc.). If we compare these facts with the qualities suggested by the corresponding adjectives we find that all those adjectives indicating a state of mind of little motor expression (groups I.-III.) have been symbolized by lines consisting chiefly of long and low waves, while those which indicate states of strong motor expression have been symbolized by lines of either short waves alone, or acute angles alone, or of both. This result can be illustrated by the following formula, in which *m* means states of mind with little, *M* with strong, motor expression and the other letters refer to the different types of waves and angles already described.

$$\text{I.}\quad m = a \qquad\qquad \text{II.}\quad M = \begin{cases} c \\ c_1 \\ c + c_1 \end{cases}$$

It has long been known that pure lines in themselves are able to suggest movements or motor states. Consequently the question arises whether there is a law for these phenomena; that is, whether certain lines suggest movement in a higher degree than others. An answer to this question was obtained by the following simple experiments. Each of the subjects was asked to draw four wave lines suggesting movements of different degrees of intensity.[1] They all drew them alike. The line of least movement had long waves of type *a*, the next had shorter waves, and compared with the length, higher waves, the third had still shorter waves and the fourth small waves of about the same type as *c*. It is to be remarked that in the last line the waves were frequently sharpened and approached acute angles. These experiments show, undoubtedly, that long and low waves suggest less movement than shorter and higher ones, and furthermore that the movement suggested by a line becomes accentuated if this contains acute angles. Several introspective statements of the subjects verify these results. A few of them follow:

[1] By intensity is meant both rapidity and the force which is read into the line.

G: There is often much movement in an angular line but this movement is of a jagged, broken, and hard character.

L: Small waves make the movement of a line go more quickly. The calm line has slow, long curves.

Mi: Sharp angles give a sensation of speed—much action. Broad curves represent more enduring emotions, while the small curves show more transitory and volatile emotions. They are more rapid.

C: Angularity of a line expresses violence of movement. If a curve is slowly undulating or sweeping it is soft. To be so, it must have long waves with low amplitude. Angles and straight lines always express violence, energy of movement. A long curve always expresses slowness.

F: Angles, especially the sharp ones, express vivacity. Short curves imply vivacity.

Many more statements of the same nature could be quoted, but those already chosen are sufficient, especially since there is not a single contradiction.

Hence we see first that lines symbolizing states of strong motor expression have short waves and acute angles and lines symbolizing states of weak motor expression have long and low waves; and second that lines with waves of the former type and acute angles themselves suggest intense motion, while lines with waves of the latter type suggest weak and slow motion. This justifies us in supposing that the affective character of lines has its origin in the suggestion of movement of the line that it depends upon the idea that this movement in some way imitates the motor expression of an emotion. This supposition becomes greatly strengthened by the fact that the subjects themselves have mentioned the movement as being of importance for the emotional expression of the lines.

How the illusion of movement itself in the pure line arises, is another problem which has been treated to a great extent in psychological literature. The only light that was thrown upon the theory of the phenomenon by the subjects was, that three of them agreed in explaining that the suggestion of movement of lines was connected with an idea of the motion of the hand in drawing them. One of the subjects connected the phenomenon with the movement of the eye in following the line; the rest did not express any opinion.

If we compare groups IV. (merry, etc.) and VI. (furious,

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etc.) in the tables, we find that in the former 50 per cent. of the lines show only small waves, and 20 per cent. show small waves and acute angles, while in the latter only 2.5 per cent. show small waves, and 64 per cent. small waves and acute angles. There is an obvious difference between the two groups, although both of their adjectives indicate states of strong motor expression. We obtain the explanation of this, however, if we examine the general introspective statements regarding the feeling tone of curves and angles, which were given during the progress of the experiments. A complete and systematical quotation of them follows:

G: Sharp angles are unpleasant—weakness can never be expressed through angles. The rapid interruption through angles gives the impression of furiosity. Angularity of a line suggests sharpness, impatience, hard-heartedness, a certain unfeeling vigor and strength. Likewise angularity implies absence of gentleness and grace. Very little refinement can be suggested by it. There is often very much movement in it, but of a jagged, broken and hard sort. It lacks high purposes; it is an unstudied line of least resistance.

Curves suggest grace, serenity and most of those physical and mental qualities acquired in civilization and education. The curving of a line gives it more maturity, it gives the poise and refinement of nature. It does not lack strength, it always expresses a high and rather moral quality of a feeling.

L: Sharp angles hurt. Angularity expresses the hard, angry, and unpleasant emotions. It indicates fire, storm, strength and power.

Curves denote grace and beauty, serenity and kindness. The finer characteristics of all elements are shown by curves. Big curves express graveness, firmness and strength.

Mi: Small angles are cruel because they remind one of stabbing points. Angularity of a line usually expresses ungracefulness, too much expenditure of energy for the execution of the intended movement. Much action. Suggests the emotion of anger, fear, surprise, excitement, all emotions which are sudden and immediate. Also expresses pain, anguish, brutality and sharpness. Obtuse angles represent emotions of a slower, less emphatic sort; sharp angles give a sensation of speed and deeper excitement and a higher point of emotional instability.

A curving line usually represents grace and economy of movement. It is pleasanter than an angular line, because it does not take so much trouble to follow it. It suggests gentle emotions, such as pleasure, happiness, gaiety, and the opposite sorrow and grief. Broad curves are more graceful than small curves and represent more enduring emotions, while the small curves show more transitory and volatile emotions. Power is expressed in big curves, even dignity.

S: Angularity means awkwardness and hardness, lack of gracefulness in the movement. I do not think a right angle could ever be soft. Could not connect an angular line with gentleness, because it is hard and sharp.

Curving of a line means sweeping motion. Anything curved, going very slowly, is mild.

C: Angles give the idea of violence and vivaciousness; they imply viciousness, anger, etc. There is a correlation between straight lines and angles, and hardness.

A long curve always expresses smoothness and slowness. Lines curving upwards express increase of *tonus*, lines curving downwards express relaxation—sometimes depression. A curve is soft if it has long, low waves which undulate in a smooth way.

D: Harshness must always be expressed with angles. The weak line has not energy enough to make angles. Angles express the absence of conscious idea. Angles in a line imply the more abrupt and violent emotional states. They represent feelings that are more or less spasmodic in expression with no special inhibition of a tendency towards marked accent. Angles are harsh and consequently striking. Angles, on the whole, express the more intense, elementary feelings.

In contrast to angles, curves in a line usually represent the more refined and purely intellectual feelings. They tend to modify and control even the most violent of emotional states and consequently are usually the more pleasing of the two. Curves also tend towards a more intimate coördination between the different elements expressed in a feeling state; and hence aid in uniform and consistent expression of any particular state or states. Curves appeal to the finer and more highly differentiated aspect of the subject.

F: Angular motion represents hard and painful feelings. Angles even tend to express strength, vivacity—sharp angles, distress; broader angles, power, determination, calmness.

Curves express grace and are usually pleasant. Short curves, grace and liveliness; long curves, beauty, indolence, calmness. Curves in general express the weaker and less forceful emotions.

Ma: Sharp angles imply the idea of pain, pricking pain, spitefulness, incongruity, instability, moodiness. Angles even imply sharpness and sudden transition, brusqueness, caustic feeling, quick temper, ugliness.

Curves imply gradual transition, the more subtle emotions, prettiness, lack of much strength, smoothness.

With the above-quoted introspection as a back-ground we can easily understand the difference in character of the lines belonging to groups IV. (merry, etc.) and VI. (furious, etc.); it is the general pleasantness of the emotions in the former group which has caused the subjects to symbolize these emotions with chiefly curved lines, while it is the unpleasant and unrefined feeling tone of the emotions in the latter group, that underlies the use of so many angles in its lines. We can likewise understand the distribution of angles and curves in groups IX. (weak, etc.) and X. (gentle, etc.) on one hand and in group XI. (hard, etc.) on the other. In the first two of these groups the curves are in a decided majority (72 per cent. and 94 per cent.) and in the latter the angles (75 per cent.) and the angles and curves (21 per cent.). The reason for the long and low waves predominating in

groups IX. and X. is without doubt that the state indicated has a weak motor expression, while the reason for the predominance of acute angles in group XI. is due to the more painful feeling tone connected with the character of the states expressed through its adjectives.

If we compare groups IX. (weak, etc.) and XIII. (powerful, etc.) which are opposite in regard to the meaning of their adjectives, it will be noticed that in the former, curves of type *b* are in a decided minority while in the latter, the same curves together with angles of type b_1 tend to predominate. These groups consequently show first in a negative and secondly in a positive sense, that high curves of medium length are the ones which above others suggest strength. Group XIII. also seems to imply that the right angles of type b_1 possess the same quality. A few introspective statements already quoted in another connection verify this.

L: Big curves express graveness, firmness, and strength.
Mi: Power is expressed in big curves, even dignity.
S: I do not think a right angle could ever be soft.
F: Broader (in opposition to sharp) angles represent power.

Finally if we examine those groups not yet treated, VII. (dead, etc.) VIII. (playful) and XII. (serious, etc.), we can easily interpret their lines from the points of view which we have already gained. VII. and XII. contain chiefly waves of type *a* (69 per cent. and 69 per cent.), obviously depending upon the inactive character of their adjectives; VIII., on the other hand, the more active group, contains chiefly waves and angles of types *c* and c_1 (50 per cent.) or waves of type *c* only (26 per cent.). Perhaps we should have expected the last number to be a little larger considering the pleasant feeling tone of the state.

Those lines which differ too widely from our categories to be subordinated to any one of them, show few traits of interest. As a rule their shapes have been fixed by one or another concrete association. In only a few cases can the deviating lines be said to form a category of their own, as for instance in group VII. (dead, etc.), where they are all horizontal straight lines, or in group IX. (weak, etc.), where a common

quality in seven of them is that they are each drawn with a consciously trembling hand. The association lying behind this is too obvious to need any description. That straight horizontal lines have been used as symbols for death and dullness has, according to the statements of the subjects themselves, its cause in their lack of motion.

Before we proceed further it mght be useful to incorporate some of the new results in the formulæ which we have already drawn up. This can be done by dividing the second of them into two new ones. Thus:

III. $$Mp = \begin{cases} c \\ c_1 \\ c + c_1 \end{cases} \qquad c > c_1$$

$$Mu = \begin{cases} c \\ c_1 \\ c + c_1 \end{cases} \qquad c_1 > c$$

Mp means an emotion with strong motor expression and pleasant feeling tone. *Mu* an emotion with strong motor expression and unpleasant feeling tone. > means more frequent than.

As already stated, the lines could also be divided into groups according to their chief direction, which is recorded in the last columns of the tables. In regard to these also, general tendencies can be established.

If we begin by giving our attention to groups I. (sad, etc.) and IV. (merry, etc.) we find that in the former 13 per cent. of the lines are horizontal, 3 per cent. inclining upwards and 84 per cent. inclining downwards, while in the latter 40 per cent. are horizontal, 58 per cent. inclining upwards and only 2 per cent. inclining downwards. The explanation is given by the introspection of the subjects, in the following statements:

The downward tendency of a line expresses relaxation, the upward expresses power. The downward tendency expresses faintness, not sufficient strength to keep up. Going downwards expresses losing of energy. The doleful line droops without energy. If it had force it would have ascended

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higher. Strength is expressed by going upwards. A joyous line also ascends. Joy is an uplifting feeling. A forceful line tends upwards. Thereby it obtains the idea of ambition. A line indicating strength is a line tending upwards, never downwards.

On not less than 57 different occasions analogous statements have been noted, and not a single one shows a tendency towards an opposite opinion.

Therefore it seems to be obvious that even the direction of the lines to a certain extent imitates the motor expression of an emotional state and that consequently the direction is one of the factors that partakes in giving them their affective tone. Direction upwards expresses strength, energy, force, ambition, uplifting feelings, etc., direction downwards, weakness, lack of energy, relaxation, depression, etc.

If we look over the different groups with attention to their chief direction, this is verified. In the groups IV., V., VI., VIII. and XIII. containing synonyms for merry, agitating, furious, playful, and powerful we find more upward than downward tending lines, while in I., II., III., VII., IX., X., XI. and XII. groups, containing synonyms for sad, quiet, lazy, dead, weak, gentle, hard, and serious, a larger number of lines tends downwards than upwards. All these facts correspond to the general differences in the emotional states so far as the qualities just mentioned are concerned.

It is interesting to note that in group II. (quiet and its synonyms) namely the indifferent group, the largest per cent. (81 per cent.) of the lines tends towards the horizontal. Why group XI. (hard and its synonyms) has more downward than upward-tending lines can not be explained through the introspection directly. The differences in per cent. (21 per cent. to 17 per cent.) is small enough, however, to make it possible that it may be due to chance.

The experiments were not carried on in such a way that they gave exact records either of the fashion in which the lines were drawn, or the time used in drawing them. Investigations concerning these could be undertaken and should give interesting results. Judging from the observations made

by the experimenter a tendency seems to exist to draw the more rapidly, the stronger the motor expression of the state of mind to be symbolized is. Thus as a rule the joyous lines were drawn much more rapidly than the sad ones. Likewise the small waves and the acute angles were generally drawn more rapidly than the big waves and the broad angles. There were exceptions, as for instance when cheerfulness was expressed through one single big upward-going half wave, drawn with great rapidity, or when excitement was expressed in an analogous way. Even the thickness of the line and the pressure of the pencil seemed to follow certain rules. Strength was very often expressed by a homogeneous thickness of the line caused by a strong continuous pressure of the hand when drawing. We have several similar introspective statements. Breadth of a line gives the impression of strength. It expresses intensity, strength and great saturation.

On the contrary, lines belonging to the group of "weak" and its synonyms are drawn as a rule so thinly that at times they can hardly be seen. One of the subjects even defined a weak line as a line that "you hardly can see." Such observations indicate that further experiments aiming to record the rate and manner of drawing the lines would be worth while.

As has already been said, the subjects were requested to avoid concrete associations as much as possible, but at the same time to mention if they happened to appear. Few associations have been noted. This, however, does not exclude the fact that such did influence unconsciously the shape of the lines, and their feeling-tone. The following is a complete record of all associations written down in the subjects' own words:

G: Sad: drooping lips, gloomy valley pits. Indolent: picturesque laziness of southern people, vagabond. Merry: childish quality, like jumping. Jolly: like a kitten. Joyous: bumping movement like a ball; a boy turning somersaults. Vivacious: harlequin. Fiery: dragon. Playful: a cat playing with a ball. Hard: undecorated wall. Strengthful: pyramids and mountains.

L: Cheerful: something rippling. Joyous: dancing. Furious: sharp points that hurt.

Mi: Merry: the country, jumping. Fiery: flames in a fire. Weak: a weak chin. Hard: saw teeth. Powerful: buildings and big waves.

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S: Melancholy: a weeping willow tree. Doleful: a doleful face. Merry: making noise. Joyous: child clapping its hands.

C: Indolent: a yawn. Merry: dance. Furious: lightning; musical associations. Sprightly: movements of a danseuse.

D: Fiery: lightning.

F: Idle: idea of walking around. Vexed: angles represent a hard and painful feeling.

Ma: Sad: a man suddenly starting up and then relaxing. Lazy: the general outline of a slope. Idle: a man doing nothing. Merry: turning round, jumping. Cheerful: dancing. Dull: a dull knife. Weak: a weak mouth. Hard: the rock of Gibraltar. Serene: the idea of thought. Serious: sort of a brain wave.

The few investigations made in order to find out whether pure color-images could be symbolized with lines show that it is chiefly the exciting and quieting elements in the colors which induce the shape of the lines. The different types of lines which we have separated are divided in the following way:

Red: $c_1 = 3,\ a = 1,\ c = 1, c + c_1 = 2$
$H = 2, U = 2, D = 2.$

Blue: $a = 5,\ b = 2.$
$H = 7.$

In the red lines we see that the small waves and acute angles are in the majority; in the blue the big and low waves. Regarding direction, all the blue lines are horizontal like the lines of group II (quiet and its synonyms). In the red lines the different directions occur in equal numbers. The introspection of the subjects gives a key to the explanation of the lines.

G: The red line is the line of gaiety, of warfare. A cruel line.
L: Red line like the furious and the fiery.
S: Red line like fire.
D: Red line like anger.
F: Red line fiery.
Ma: Red implies great intensity, energy, and saturation.
G: The blue line is gentle, placid, and calm.
L: Blue line is serene like quiet water.
S: Association from the quieting blue sky.
D: Blue line is sad.
F: Blue line is calm and faint.

In some cases no introspection was given by the subjects. There is a certain interest in observing that with the color lines concrete associations seem to have been more lively

than with the other lines. If we connect the facts noted with our previous results it is quite obvious that the red line is the active and energetic type, while the blue is quiet.

The material gained from the drawing of beautiful and ugly lines can not be classified according to our previous basis of separation. The types of lines are too varied. The introspection, nevertheless, hints at general tendencies in drawing those lines.

BEAUTIFUL

G: Gradual curves. The line gives what is expected. No interruptions in it. A beautiful line is always symmetrical. There is a dignified quality in the beautiful line. It is smooth.

L: Graceful movement is connected with a beautiful line. It glides along and is always made up of curves. Association: waves of the sea.

Mi: A beautiful line has continuity and is not crossed by any other line. Association: a swan.

S: A circle is a beautiful line. It is satisfactory because it is symmetrical and curved.

C: A beautiful line swings smoothly and is round and curved. All the curves have the same form. Smoothness and roundness are necessary for a beautiful line.

D: A beautiful line has a harmonious fusion of its different parts. It has a certain symmetry and very little conflict. It expresses a single and harmoniously blended idea.

F: A beautiful line is symmetrical, smooth and round.

Ma: Gradual transition is necessary in a beautiful line. It cannot have any straight parts. It is sweeping.

UGLY

G: The ugly line is just like a mass. Curves, angles and straight parts are mixed together, without organization. You get ready for a curve and then you have something else. Constant changes from unpleasant to more unpleasant.

L: An ugly line must have angles.

Mi: An ugly line has no continuity. Straight lines, curves and angles are mixed up.

S: The ugly line goes nowhere. Has no feeling.

C: The ugly line is a sort of conglomeration; is meaningless and broken up. It is like a mass. No uniformity in the curving. The intersections make the line ugly.

D: Ugly lines have no unity, no harmonious fusion between curves, straight lines, and angles. A conflict of different emotions is caused thereby. The curved line has one feeling-tone, the angles another, and the straight parts a third. Even a conflict of movements.

F: The ugly line is asymmetrical and has angles.

Ma: In ugly lines there is a conflict between different parts. The unrelated spaces make the line ugly.

We can easily deduce from these introspective statements that certain qualities are necessary in a line in order that it will appeal to us, and that the absence of these qualities makes

the line ugly. The chief criteria of a beautiful line seem to be the following: unity in direction and movement, continuity, absence of angles and intersections, a periodical return of the same elements or a certain symmetry.

Summary

A résumé of the chief results regarding the affective tone of lines gained through the experiments can be formulated in the following sentences.

There seems to be a feeling tone connected with pure lines, which is perceived by a majority of observers.

This feeling tone is probably dependent upon the suggestion of movement in the lines; that is, the lines appear to imitate in their movement the motor expression of emotional states.

Slow and weak movement is suggested by lines with long and low waves, rapid and intense movement by lines with small waves and acute angles.

Consequently, emotions with little motor expression are suggested by lines of the former type and emotions with strong motor expression by lines of the latter.

A finer differentiation of the emotions suggested is not possible. Sad, lazy and quiet lines have practically the same shapes; likewise the furious and exciting are similar.

When sharp angles predominate in a line of the active type, it seems to acquire an unpleasant feeling tone, as well as an increased intensity in its movements. Thus, a jolly and a furious line differ in the frequency of the acute angles.

Strength is very often expressed by big and high waves; and even by right angles at times.

Broadness of a line indicates strength, while thinness indicates weakness and faintness.

Beauty in a pure line is expressed by unity of direction, continuity, roundness of curves, lack of angles, and periodical repetition of similar elements, or by a certain symmetry; ugliness by the reverse of all these qualities.

With these facts in mind we can understand why pure lines are an emotional factor in art and why they are an important factor in our enjoyment of the great masterpieces.

THE LAW OF HABITUATION

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There is a rather large group of facts of an æsthetic order that apparently have not received full recognition. They have not been differentiated from the general mass of conscious experience, nor adequately described by any existing psychological principle or law. They have consequently not been given any distinctive name. The only way I can refer to them, therefore, is to point out a few of their most striking examples.

The instance of these facts that has been most carefully studied up to the present time is the development of the feeling of consonance. The Greeks recognized only the octave as a consonance; in the fourth century the fifth and fourth were accepted; in the eleventh the major third; in the twelfth the major and minor sixths; and today we seem to be on the verge of accepting the sevenths, if we have not already done so. This orderly change of appreciation, or value mutation, attracted the attention of H. T. Moore and suggested a series of experiments performed by him,[1] in which he succeeded in artifically changing the appreciation of his subjects as a result of repeated stimulation. Comparable to these changes in the appreciation of musical intervals are changes in the appreciation of timbres. The modern ear enjoys far more complex timbres than the ear of a century ago. Even Wagner's music which to us seems easy to appreciate was called in his day 'shrill noise and broken crockery effects.' The rapidly increasing size and complexity of the modern orchestra is the external indication of the internal change going on in the public mind. Color combinations are also subject to changes of appreciation. The average person has

[1] 'The Genetic Aspect of Consonance and Dissonance,' *Psychol. Monog.*, No. 73, Sept., 1914.

distinct likes and dislikes among color combinations, probably more combinations being disliked than liked. But with those artists who are essentially colorists there seem to be very few and sometimes perhaps no color combinations that are truly disliked.[1]

Something of a similar sort seems to hold with regard to linear proportions. The layman may have distinct preferences for particular proportions, the golden sections and its neighbors, for instance, but an architect pays little or no attention to these simple proportions. Indeed, the relation of the lengths of lines to one another seems to be such a negligible factor to him that he generally means by proportion a totally different thing. In this connection the gradual thinning in the course of time of all the architectural members of the classic temples is perhaps significant. Compare the squat early Doric temple with the slim and lofty Roman temple. There is a somewhat parallel thinning out of proportions from the early Romanesque to the extreme Gothic.

In verse rhythms we can detect similar changes proceeding there in cycles. For instance, consider the strict metrical rhythm of Spencer and his time, the freer rhythm of the Shakespearean dramatists becoming freer and freer even in Shakespeare himself till it broke down into virtual prose in Webster, then the gradual tightening to the strict metrical rhythm of Pope, the loosening of the rhythm with the Romanticists, and again its break down to virtual prose in Browning, Whitman, and the whole modern school of *Vers Libre*. Examples of this sort could be multiplied out of the history of the arts. And among such examples must not be omitted the cycles of fashion in dress, furniture, gardens, and the host of minor arts.[2]

All of these are undeniably changes in appreciation, value mutations. There is furthermore apart from minor differences a generic quality about them that suggests that they are various manifestations of a single principle. In one place

[1] S. C. Pepper, 'Changes of Appreciation for Color Combinations,' PSYCHOL. REV., 1919, 26, 389–396.

[2] A. L. Kroeber, 'On the Principle of Order in Civilization as Exemplified by Changes of Fashion,' *Amer. Anthrop.*, 1919, 21, 235–263.

and another where a psychologist or a critic is driven to explain some of these facts, we find it vaguely intimated that they are due to imitation, or habit, or fatigue, all well recognized psychological principles. But the very number and diversity of these principles casts suspicion on the adequacy of any of them.

Imitation is undoubtedly a prominent factor in any social phenomenon, and therefore also in this one. If it comes to be thought 'the thing' to appreciate Browning or Gaugin, the flock may grow to appreciate them largely from the influence of social suggestion. But there must always be at least a small group who began to like these things without the pressure of social suggestion. At the very least there was the artist who made the work of art. When discussing the fashions, it is usual to say at this point that of course it is merely a game on the part of designers and storekeepers to keep up a constant flow of sales. We hear the same thing said even of artists. There may be a few exceptional cases where the insinuation is true. But those who make it universal are ignorant of the lives of artists. Shelley, Beethoven, and Rembrandt were not making what their contemporaries considered queer works of art as a money-making scheme. They were following the dictates of their taste, and their taste differed from the general run of their contemporaries. In a lesser way the same is probably true of designers in the minor arts. Indeed, strict reasoning from the principle of imitation would make changes of appreciation utterly impossible, for if taste were wholly governed by imitation, the taste of artists would be also governed by imitation and the art of each age would then have to be essentially similar to the art of the age before. That obviously is by no means the case.

The principle of habit leaves us in the same difficulty. It is said that we get used to strange things from seeing them often, and then we are able to appreciate them. But again we must ask, where did the strange things come from in the beginning. The work of art must first exist before we can get used to it, but the artist is apparently used to it before

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it exists. Habit is a conservative principle, but the principle at work here is radical. These changes of taste are what disrupt schools rather than crystallize them, and it is this active disruptive power that we must explain. Furthermore, habit has a tendency to drag all elements towards affective neutrality, and if possible into unconsciousness and mechanism. When we get used to the picture on our living-room wall, we virtually do not see it any more. That is why many people of sensitive taste change their pictures often. But the principle we must discover in order to explain our group of facts is one that increases our appreciation of things, not decreases it. It does not change our appreciation of all musical intervals to affective neutrality, but to rather high liking; nor of all color combinations to indifference, but to positive delight. As with imitation, our principle, whatever it may be, must at root be opposed to habit rather than allied with it. Far from being identical with habit, our principle must be strong enough to break through it and overcome it.

The principle of fatigue is more plausible. It is pointed out that when we hear too many consonances in succession we get tired of them and crave a dissonance. After a certain amount of sweet we crave sour. In the same way, it is said, after a number of years of tight skirts we crave full skirts, and after a century or so of the rigid rhythms of Pope we crave the looser rhythms of *vers libre*, and after ten centuries of octaves we crave the piquancy of the perfect fifth. There is an analogy between the principle of fatigue and the principle we are seeking, but upon consideration obviously a very distant one. For fatigue is rarely a matter of more than a few minutes, hours at most. It is terminated with sleep at the latest. But the principle we are in search of is something that runs over years and centuries. Two hours after we have been satiated with sweets we are ready for another sweet, and the desire for the sour we craved has disappeared. Twenty minutes after we have been fatigued with a monotony of consonances we are prepared to listen with pleasure to some other consonances, and to hear a dissonance unprepared would be painful. But the principle we are searching for

must explain how a dissonance can come to be liked by a person as a consonance and (apart from the action of fatigue) be permanently liked. The principle of fatigue works on top of the principle we are searching for, and is of very much shorter duration, and probably of a fundamentally different nature.

It would appear, therefore, that the principle for which we are seeking is not a recognized psychological principle and consequently has not received a name. It occurred to me that 'habituation' might be as apt a name as any for it. And it seemed to me important some name should be given to the principle even if we did not know what the principle was, because if we can say the group of facts referred to at the beginning of this paper is governed by habituation, that at least signifies that it is not governed by imitation or habit or fatigue or any other recognized psychological principle, and that therefore a problem exists to discover what the principle of habituation is.

The solution of this problem consists in the accumulation, classification, and careful analysis of quantities of such facts as I referred to at the beginning, and a final generalized description of their behavior. Nothing of this sort has been done, least of all by me. All I wish to do is to call attention to an unsolved psychological problem of considerable magnitude, the very existence of which has hardly been noticed. The description of the law of habituation which follows is not to be regarded as more than most vaguely hypothetical. My hope is that by making a definite statement as to the nature of the law, criticism may be stirred up together with an active interest to discover by observation and experiment what the real nature of the law is.

Habituation seems to imply the existence of strings of connected dispositions. I propose to call such strings 'affective sequences.' An affective sequence is a group of connected dispositions such that if there is any affective change in one member of the group, there will be a definite affective change in every other member of the group. In other words, the group of dispositions works as a whole; an affective change in

any one member of the group entails an affective change of the whole group. Such a sequence of dispositions would be that for the appreciation of musical intervals. The octave is most easily liked, then the fifth, then the fourth, then the third, then the sixth, then the seventh, and then the second. Now with the Greeks the octave alone was liked, the fifth was probably slightly disliked, the fourth a little more disliked, the third a little more, the sixth still more, the seventh still more, and the second yet still more. Due to some cause the fifth in the fourth century became very much liked. That meant that the octave was not so much liked as with the Greeks, while the fourth, third, sixth, seventh, and second were all more liked. A change in the affective disposition towards the fifth entailed a change in the affective dispositions towards all other intervals. The whole series of dispositions towards musical intervals hangs together and moves as a whole. That is what I mean by an affective sequence.

There are probably affective sequences for every class of psychological elements—affective sequences for single pitches, single timbres, single colors, single tastes, single smells; also for some classes of perceptions—for single lines, single rhythms, and the like; also for simple combinations of psychological elements, such as for musical intervals (combinations of pitches), and color combinations; and also for simple combinations of perceptions, such as combinations of lines and rhythms. These are separate affective sequences, because changes in one of these sequences have no direct influence upon other sequences. That is to say, a change in a person's appreciation of musical intervals does not create any change in a person's appreciation of color combinations. Thus an artist with a completely (so-called) educated taste for colors may have a very naive taste for music. There may, however, be relations of dependency between certain affective sequences and others. It seems probable, for instance, that a man's taste must be completely educated to single colors before he can proceed far with combinations of colors. In other words, there must probably be pretty complete habitua-

tion in the affective sequence of single colors before there can be any great changes of appreciation in the affective sequence of combinations of colors.

The condition of an affective sequence in an individual prior to any change of appreciation in its dispositions—*i.e.*, for example, the condition of an affective sequence at birth—I shall call the 'natural affective sequence.' The natural affective sequence for musical intervals, for instance, is probably a graded dislike for all intervals except the octave. Natural affective sequences are probably about the same in all individuals, just as the primitive system of reactions (instincts, if you wish to call them such) are essentially the same in all individuals. These natural affective sequences are the crude materials on which habituation begins to work. And since these crude materials are (barring slight individual differences of aptitude and the like) the same in every one, the differences of taste we see about us are entirely the result of habituation.

The active element that causes the changes of appreciation in affective sequences is stimulation. The rapidity of the change of appreciation within an affective sequence is a function of the frequency and vividness of the stimulation and probably of some other more recondite factors also. It takes a certain amount of stimulation to produce a change in an affective sequence, the larger the amount and the more strongly reacted to, the more rapid the progress of habituation. There are also other factors probably not reducible to these. For example, stimulation of dispositions just below the point of affective neutrality seems to produce more rapid habituation than the stimulation of dispositions situated elsewhere in the affective gamut.

We are now able to describe roughly what the course of habituation is. It begins always on a natural affective sequence. The natural state of an affective sequence differs with each sequence. In the sequence of pitch intervals, as we just saw, the line of affective neutrality comes just after the octave, all other intervals being disliked in the natural state of the sequence. In the sequence of color combina-

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tions, however, there are probably a considerable number of combinations that are liked in the natural state, though most color combinations are disliked. And in the sequences of single pitches and hues nearly all the elements in the sequences are probably liked in the natural state. The position, therefore, of the line of affective neutrality in the natural affective sequence differs for each sequence, and has to be discovered separately in each case.

There is a general rule that seems to be roughly true, however, and that is that the more complex the elements of a sequence, the less the number of elements in it that will be liked in the natural state of the sequence. Thus as a combination of pitches is more complex than a single pitch, there will be more elements liked in the natural affective sequence of single pitches than in that of combinations of pitches. Indeed the rule of complexity goes even farther, for where there is a difference of complexity among elements in a single affective sequence, the simpler elements are more apt to be liked in the natural state, the complex ones to be disliked. So it is with musical intervals, and with timbres, rhythms, and proportions; the octave, the pure tone, the tum-tum rhythm, and the one to one relation of clear symmetry are the simplest elements in their respective sequences and the most easily appreciated. But it is difficult to see how the rule could be made universal, for there seem to be affective sequences of elements that cannot be said to differ in the least in respect to complexity. There is no difference of complexity, for instance, among single colors, and yet there seems to be an affective sequence. In short, where there are differences of complexity whether among the elements of a single sequence or among whole sequences, the simpler elements and the simpler sequences seem to be the easier to appreciate. But the rule of complexity is not adequate to explain the relative ease of appreciation (or in other words, the relative position of the line of affective neutrality) in all cases, because there seem to be affective sequences where there are no differences of complexity.

The natural state of an affective sequence, then, (which

has to be discovered for each sequence) is the starting point for every habituation mutation; and repeated stimulation of the dispositions composing the sequence is the motive power that produces the mutation. In order to make the progress of habituation clear, let us imagine an affective sequence composed of four elements only, viz., *a*, *b*, *c*, and *d*; and let us assume that in the natural state of this sequence *a* is very much liked, while *b*, *c*, and *d* are disliked, *b* a little, *c* more, and *d* still more. The line of affective neutrality would then fall after *a* and just in front of *b*. This situation is diagrammatically represented in (1) (cf. Diagram). That is to say, (1) represents the natural state of our imaginary affective sequence.

Now, as a result of repeated stimulation, that sequence will pass through stages (2), (3), and (4), which constitute the first phase of the mutation. In each of these stages a new element is brought from dislike to liking, a change which entails changes in all the other elements of the sequence. The element newly liked jumps from dislike to extreme liking with a single leap. And this leap is characteristic of habituation. When a fresh element is gained for liking out of the limbo of dislike, it is showered with adoration like a new social hero, until another fresh element comes out of the limbo and shoves its predecessor aside into the company of the stale heros. Musicians will recall the consecutive fifths and fourths of the ninth and tenth century songs. These intervals newly gained for appreciation could not be too often repeated but were called for over and over again. Later the thirds shoved them aside, and then consecutive fifths became the cardinal sin of harmony.

The first phase, which I have called the continuous phase, proceeds until all the elements of the affective sequence (or nearly all) have been drawn from dislike to liking. This process is what is largely meant by 'education of taste.' A thoroughly educated taste is a thoroughly habituated one.

But a time comes when all or practically all of the elements are liked. Then the second phase of the mutation begins which I have called the cyclic phase. This is represented diagrammatically by stages (5), (6), (7), and (8). It consists

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in a movement forward and back from extreme to extreme of the affective sequence. At (4) *d* is most liked, at (6) *a*, at (8) *d* again. And between the periods when the extremes are most liked, the means are most liked. This pendulum swing is clearly seen in the case of verse rhythms above referred to.

It is probable, however, that when the elements of an affective sequence are extremely simple the cyclic phase of habituation is absent. Affective sequences, for instance, of single colors, single pitches and the like have no cyclic phase. Such elements once they have been drawn out of the field of dislike are absorbed into a rather intense and indiscriminate liking. But the more complex the elements of an affective sequence, the more clearly the cyclic phase exhibits itself. It is as if there were only a certain limited capacity of appreciation, as there is only a limited capacity of attention. And as in the case of attention when we cannot attend to all the elements of a complex whole at once, we make up for our deficiency by attending to each of the elements in succession; so apparently in the case of appreciation when we cannot like all the elements of an affective sequence equally, we make up by intensely liking each of the elements successively. The prominence of the cyclic phase, therefore, is a function of the complexity of the elements composing the affective sequence.

In short, as a result of repeated stimulation the elements of an affective sequence are first drawn from dislike to liking; and then in case the elements are too complex to be absorbed into a rather intense and indiscriminate liking, the affective sequence acquires a new movement, a pendulum swing from extreme to extreme of the sequence through a point of intense liking. This mutation in both of its phases is a matter of months, years, and even sometimes of centuries.

Where the mutation is a matter of months and years, it is obviously explainable entirely in terms of individual psychology. A query, however, might arise how the mutation could cover centuries—as apparently it often does—seeing that the life of a man does not exceed four score and ten. It does not seem to me necessary to postulate an over-

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individual social organism to explain this fact. What the fact means is that it takes a great deal of time for individuals to work up to an appreciation of new elements when these elements have not found a place in the art of the age.

It took us seven centuries of music to work up from the fourth and fifth to the major third, because during that period the fourth, fifth, and octave were the only intervals commonly heard and the major third was used only timidly and apologetically. Furthermore, a shell of custom (habit) in the form of papal edicts surrounded the fourth, fifth, and octave which had to be broken down by the impact of habituation before the major third could gain acceptance. A child of the eighth and ninth century, therefore, had no opportunity to become habituated beyond the interval of the fourth. But for a child of the eleventh century, after the major third had broken through the constraint of custom and was to be met with in music on every side, it was a quick matter to become habituated to the third and then be ready for habituation to the next element of the affective sequence.

So, through the stimulation of the prevalent art of an age the children of each generation rapidly catch up to the taste of their parents, while their parents are making but slow progress in habituation. That is what causes the habituation mutation frequently to run over whole centuries. Yet in every case the explanation lies in the psychology of individuals, in the movement of affective sequences within single organisms.

DIAGRAM. ILLUSTRATING LAW OF HABITUATION

Continuous Phase.	*a*	| *b c d*	(1)
	b	| *c d*	(2)
	a *c*	| *d*	(3)
	b a *d*	|	(4)
	c b a		
	c d *b a*	|	(5)
Cyclic Phase.....	*a*	|	(6)
	b c d *c d*	|	(7)
	b a *d*	|	(8)
	c b a		

XXVII. THE EFFECT OF CAFFEIN AND ACETANILID ON SIMPLE REACTION TIME[1]

BY WALTER SCHILLING

The drugs used in this work were caffein alkaloid (*Caffeina;* U. S.) and acetanilid (*Acetanilidum;* U. S.). They were administered in the form of capsules containing 5 grains each. Sugar of milk was also administered in a similar dose as a "control." It is of the same appearance as the drugs and has a negligible physiological effect.

The subjects were student volunteers who were called on for three periods of fifty minutes each. In nearly every case it was so arranged that the succeeding periods fell one week apart at the same hour as the first one. None of the subjects had used the drugs under consideration, except as they occurred in coffee and tea, or, very rarely, in headache remedies.

The apparatus consisted of a Hipp Chronoscope with the necessary connections for operating without springs, according to Dunlap's method; when tested previously it showed a variable error which did not exceed 1.4 σ, and absolute errors as follows: at 100 σ the readings are 10 σ too low, at 200 σ and 250 σ they are 30 σ too low. These absolute errors, be it noted, insofar as they affect the results, do so in the direction of tending to hide rather than to increase the tendencies discovered.

In addition there was provided for the subject a sphygmograph, applied to the external carotid artery, and a pneumograph with the necessary devices for recording on a kymograph. A pneumatic contrivance also recorded the instant that the stimulus was given. A clock, connected electrically with an indicating needle, marked ten-second intervals on the record. Screens were set about in such positions that the subject could not see either the mechanism of

[1] From the Psychological Laboratory of the University of California.

the chronoscope, the moving part of the kymograph, or the experimenter's key.

The reaction was an auditory one, the warning signal being the starting of the chronoscope mechanism, and the stimulus itself the click made by engaging the clutch in the chronoscope when the stimulus circuit was closed.

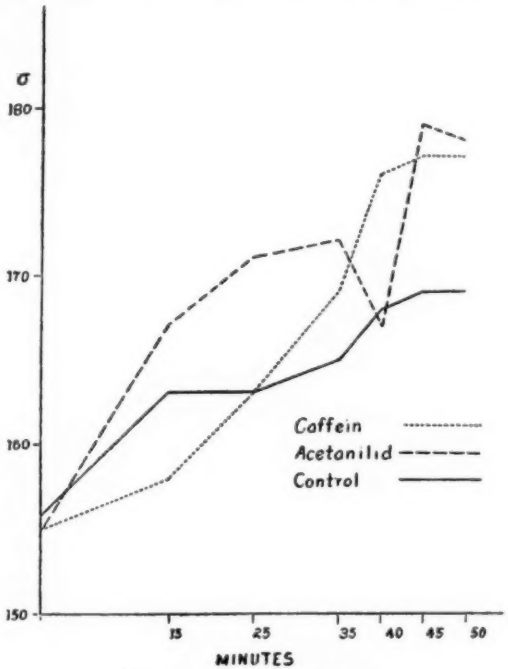

FIG. 1. Mean Reaction Time.

Immediately after taking a capsule containing either a drug or the control, about ten practice reactions were given in order to familiarize the subject with the method of procedure. The taking of the 'normal' series of twelve reaction times immediately followed. These were always completed within ten minutes, a time too short for any other than a suggestion effect and a possible physiological effect resulting from the stimulation of the alimentary tract due to the swallowing of the capsule, regardless of its contents.

The capsule did not, in all probability, dissolve for ten or fifteen minutes, and by the time that the drug had been absorbed into the system, twenty or thirty minutes would have elapsed. The 'normal' was usually completed within seven minutes after swallowing the capsule.

Further records of twelve reactions each were taken at successive intervals of fifteen, twenty-five, thirty-five, forty, forty-five and fifty minutes after administration. This completed the first series of tests for the subject. He appeared again, usually a week later, and for a third time after still another week. The procedure was the same on each occasion except that the contents of the capsule were different. No regular order was followed in the administration of the drugs or the control.

Of the twelve reaction times in each series the mean was found, and the two reaction times deviating most from this mean were cast out. The mean of the remaining ten was then considered the result for that period of time and for the drug in question.

The figures for the mean reaction time (*MRT*), the probable error *PE*,[1] the standard deviation *SD*,[2] and the ratios *SD*/*MRT* are given in Tables I, II, and III. (Cf. Fig. 1.) The mean reaction time at the end of fifty minutes is slower in nearly every case than it was at the beginning of the experiment,[3] but the retardation where drugs had been used is somewhat greater than with the control dose. The figures

[1] The probable error of the mean reaction times were obtained by the formula:

$$PE_M = \frac{0.6745SD}{\sqrt{n}},$$

where $n = 20$, and where the deviations used in computing *SD* were the deviations of the mean reaction time for each subject from the mean for all the subjects.

[2] The standard deviations (*SD*) were calculated for the individual subjects by means of the formula:

$$SD = \sqrt{\frac{\Sigma(d^2)}{n}}.$$

The *d*'s in this case were the differences between the individual reaction times in each series of ten, and their mean. The *SD*'s so obtained were averaged for the twenty subjects.

[3] Caffein: 17 subjects slower, 3 faster; Acetanilid: 17 slower, 3 faster; Control: 16 slower, 4 faster.

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for the latter probably represent, with a fair degree of accuracy, the effect of fatigue as well as the mental excitement attendant on the experiment. In general therefore, it appears that the drugs slow the reaction time more than would normally be the case without them.

TABLE I

MEAN REACTION TIMES FOR CAFFEIN IN σ

Subject	N	Interval After the Dose, in Minutes.					
		15	25	35	40	45	50
1	204	213	200	190	178	197	201
2	139	127	150	134	156	163	151
3	188	201	190	174	178	179	193
4	165	158	159	189	188	189	182
5	161	146	171	202	197	164	176
6	123	122	136	135	149	162	165
7	157	147	181	155	165	189	178
8	149	133	128	141	144	151	137
9	152	214	165	174	190	142	165
10	144	160	149	163	195	163	173
11	141	129	147	148	164	144	160
12	138	162	166	209	196	266	241
13	147	136	155	167	172	168	152
14	165	198	185	181	180	196	228
15	129	140	166	144	171	171	155
16	151	169	164	191	206	202	171
17	175	156	167	159	156	178	162
18	144	148	162	176	160	166	180
19	182	169	168	197	224	200	218
20	150	129	153	148	144	146	153
Mean	155	158	163	169	176	177	177
P.E.	3.0	4.2	2.6	3.4	3.4	4.2	4.0
S.D.	20.0	21.9	23.4	26.1	25.9	23.0	21.7
Ratios S.D./M.R.T.	12.9	13.8	14.3	15.4	14.7	12.9	12.2

The individual reaction times for all subjects, from 35 to 50 minutes inclusive, were lumped (Table IV) resulting in the ogive presented in Fig. 2. There were 800 reaction times per drug, but as some of them fell so far from the main body as to be classed as idiosyncracies, the number represented by each curve was reduced to 765. Reference to Fig. 2 shows that the reactions under the influence of the drugs is slower for all groups of reaction times, barring a slight speeding up with acetanilid in the 111–120 σ group. This may be taken as a quite definite indication, as the curves are based on the individual raction times, irrespective of the different subjects. Acetanilid seems to show faster reactions than caffein when

the reaction times are under 190 σ, but when over this, caffein appears to give faster reactions.

An attempt was made to determine any difference in the effect of the drugs on smokers and non-smokers. On this basis, a division of the subjects was made into two groups,

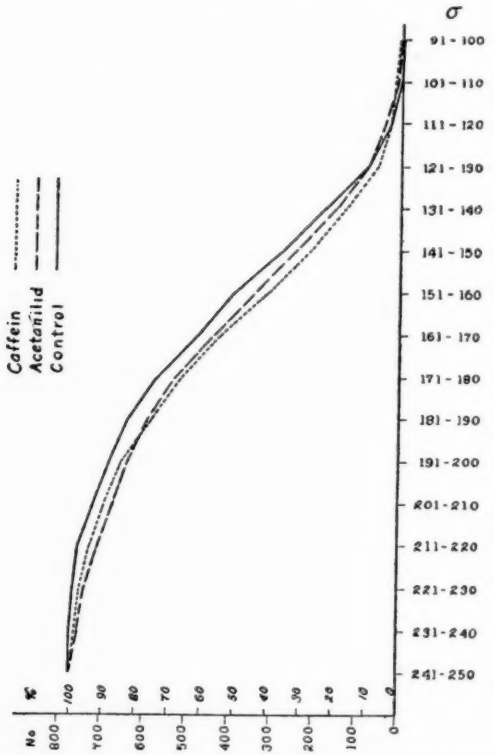

FIG. 2. Cumulative Frequencies of Reaction Times for Different Limits of Speed.

the first, or 'smokers' group, containing 11 subjects, and the second, or 'non-smokers,' comprising 9 individuals. It will be observed (Table V.) that the numbers give no indication of any clear effect from the use of tobacco.

The figures seem to show that the deviation—that is, the unsteadiness under the influence of the drugs—is greater

than with the control.[1] That these results are not due merely to the changes in the absolute sizes of the reaction times, may be observed by referring to the ratios *SD/MRT* (Tables I., II., and III.).

TABLE II

MEAN REACTION TIMES FOR ACETANILID IN σ

Subject	*N*	Interval After the Dose, in Minutes					
		15	25	35	40	45	50
1	205	198	200	219	223	253	244
2	120	128	141	162	156	173	152
3	171	193	234	206	196	203	244
4	161	176	172	162	154	195	169
5	133	157	161	177	177	190	200
6	172	145	149	155	158	156	166
7	120	123	122	131	135	131	133
8	151	190	149	181	139	148	148
9	135	136	147	157	131	140	141
10	155	151	158	160	168	177	168
11	126	148	151	141	141	156	130
12	173	173	177	197	191	202	220
13	149	246	155	151	157	151	164
14	208	198	242	197	174	193	177
15	153	191	169	221	167	204	165
16	165	160	164	190	196	198	227
17	148	151	174	154	152	167	180
18	173	172	167	173	174	194	191
19	155	171	218	188	208	197	191
20	134	141	167	152	147	149	147
Mean	155	167	171	172	167	179	178
P.E.	3.0	4.4	4.6	3.9	3.7	4.4	5.1
S.D.	22.6	25.9	26.8	27.2	18.8	24.1	23.7
Ratios S.D./M.R.T.	14.5	15.5	15.6	15.9	11.2	13.4	13.3

Respiration and pulse rate showed some interesting variations as affected by the stimulus. Some of the subjects maintained a normal respiration and a normal pulse throughout the experiment. Others showed irregular respiration and a normal pulse. Several indicated exactly the reverse; while one record presented evidence of great disturbance when the stimulus was given. In this case the subject moved the reaction key not only by contracting the muscles of his fingers, wrist and arm, but also by contracting his chest and neck muscles suddenly.

[1] *SD* with caffein greater in 12 subjects and with acetanilid greater in 14 subjects than with the control.

TABLE III

MEAN REACTION TIMES IN CONTROL EXPERIMENT IN σ

Subject	N	Interval After the Dose, in Minutes					
		15	25	35	40	45	50
1	236	211	186	215	213	196	206
2	144	131	138	134	151	127	168
3	155	188	174	164	178	186	192
4	161	164	194	165	162	173	178
5	153	184	160	166	169	161	178
6	138	140	148	166	148	150	136
7	122	126	147	129	128	143	133
8	133	149	140	144	144	151	152
9	141	189	162	166	189	171	201
10	148	149	162	153	161	174	149
11	155	149	153	143	148	144	159
12	195	170	158	291	226	197	210
13	142	156	157	163	155	176	164
14	188	216	191	186	197	180	178
15	129	146	144	125	146	140	136
16	170	192	217	183	178	263	168
17	152	153	155	149	159	171	190
18	142	158	156	157	182	177	174
19	158	137	163	146	179	155	160
20	152	156	146	158	156	146	155
Mean	156	163	163	165	168	169	169
P.E.	3.8	3.8	3.0	5.3	3.6	4.3	3.4
S.D.	21.8	24.5	21.8	21.8	22.1	22.0	18.0
Ratios S.D./M.R.T.	13.9	14.4	12.7	13.2	13.1	13.0	10.6

TABLE IV

CUMULATIVE FREQUENCY OF REACTION TIMES FOR THE DIFFERENT LIMITS OF SPEED

Reaction Time (σ)	Caffein	Acetanilid	Control
91–100	2	2	2
101–110	10	6	6
111–120	23	31	24
121–130	56	78	78
131–140	128	150	175
141–150	208	242	267
151–160	305	340	369
161–170	415	436	471
171–180	508	522	563
181–190	580	584	638
191–200	646	635	678
201–210	686	666	714
211–220	721	702	742
221–230	746	730	758
231–240	757	753	765
241–250	765	765	765

The evidence brought forward therefore, so far as it goes, gives the following indications:[1]

[1] It should be understood that whenever the terms caffein and acetanilid are used, they refer only to 5 grain doses in capsules.

1. Caffein and acetanilid each retard reaction time. The effect is more pronounced in the case of caffein.

2. A greater unsteadiness appears to be produced by either of the drugs than by the control.

TABLE V

MEAN REACTION TIMES OF SMOKERS AND NON-SMOKERS

	N	Interval After the Dose, in Minutes					
		15	25	35	40	45	50
Caffein							
Smokers	147	150	155	166	174	178	189
Non-smokers	165	168	173	173	177	175	174
Acetanilid							
Smokers	157	162	171	168	168	177	174
Non-smokers	153	175	170	175	166	182	182
Control							
Smokers	157	158	161	168	170	169	164
Non-smokers	155	167	164	160	166	169	175

There are no especial indications with regard to the pulse and the respiration. The effects, if they exist at all, are masked by the direct mental effect of taking the capsules.